THE

ELECTRICAL REVIEW.

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J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1893,

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BOARD OF TRADE AND INSURANCE REGULATIONS.

THE Board of Trade have recently issued to various supply companies who possess statutory powers what they term a model form of regulations and conditions for securing the safety of the public and for securing a proper and efficient supply of electrical energy. This model form appears to be a re-issue, without substantial modifications, of the previous "regulations as to safety in the mains and for conductors, the conduits, converting stations, the attachment to the consumer's premises, and contains special regulations as to aerial conductors when erected with the necessary consents." The latter portion contains the two rules that have been so often objected to, and about which so much discussion has arisen, viz., the thickness of the insulation necessary, and the necessity for use of suspending wires for all sizes of conductors. As this issue of a model form occurs simultaneously with the appointment of a committee of the Institute of Electrical Engineers, for the purpose of investigating the extent to which the Board of Trade regulations, as already drawn up, affect the progress of the industry, this appears an opportune time to consider this highly important matter.

It is nearly two years since Mr. Crompton first brought to the notice of the Electrical Section of the London Chamber of Commerce the fact that the Board of Trade regulations as regards thickness of insulation had the effect of making the cost of distribution of energy by overhead wires unnecessarily expensive. From that time, up to the present, several attempts have been made to induce the Board of Trade to reconsider the matter; but such representations met with a uniform refusal, and at a meeting of the Section held recently at the Chamber of Commerce, Mr. Crompton pointed out that now that the question is being once more ventilated, it is for the industry, as a whole, to consider how far the powers which Parliament has committed to the Board of Trade, in respect of the public safety, entitles them to issue regulations in such minute detail as they have done. We think that the whole of the electrical industry will agree with Mr. Crompton that it was never the intention of Parliament that at such an early stage in the development of electrical distribution of energy, the Board of Trade should step in and compile a series of regulations, defining, with extreme minuteness of detail, the exact manner in which such distribution was to be carried out, what materials are to be used, and to lay down, as if it were a fact ascertained beyond possibility of dispute, the exact thickness of insulation that is required to assure the public safety. Our view of the matter is, that the Board of Trade should confine their rules to a few general requirements as to safety and regularity of the supply, leaving to their own inspectors the responsibility of deciding whether their requirements are properly met by the various companies who are working

under statutory powers. There could be no possible objection to the Board of Trade demanding that when certain systems are used in which the maintenance of a high degree of insulation is of great importance, that a periodical return of tests of insulation should be furnished. We think that when a supply company has completed its works and is ready to cater for the public, it ought to be sufficient for it to give notice to the Board of Trade that it is about to commence the supply, that certain insulation tests have been made, and that the works are ready for inspection by the Board of Trade official, so that the latter may satisfy himself that all reasonable requirements to assure the safety of the public and for the continuity of the supply have been carried out. If this were done, the regulations as to safety may be limited definitions of the inspector's requirements, *i.e.*, may relate to differences of high and low pressure supply, to what is considered innocuous and what is dangerous leakage, up to what point in the consumer's premises the reponsibility of the supply company should extend, and the extent of leakage in the consumer's premises which would justify the supply company in cutting them off from their circuits; and as regards overhead wires, the height of the wires above the streets, the extreme length of spans allowed, and the mechanical factor of safety and strength for the conductors and supports.

We are not aware of any other industry over which the Board of Trade exercises its control in which it has attempted to define with such minuteness the nature of the works that are to be carried out; in fact, in which it has so much usurped the position of the designing engineer. We believe that it will be universally admitted that neither invention or improvement will find full scope in any industry which is fettered by iron-bound rules issued by a Government, or any other body, which is in a position to enforce such rules; and we think that the Committee of the Electrical Trades Section has done wisely in signifying its intention to resist such action on the part of the Board of Trade, and, if possible, to induce them to take a more reasonable attitude.

NINETY MILES AN HOUR.

THE raising up of a velocity of 90 miles hourly in a locomotive of 70 tons, with a train of 150 tons or more behind, is like creating a monster to lay, and places us in Frankenstein's position.

Few realise what is implied by such a speed. It is equivalent to a distance of nearly 45 yards passed over in one second. The extravagant claims put forward for electric traction by some who have very little perception of the facts involved, have possibly led Mr. Westinghouse to publish some figures in the *Railroad Gazette* bearing upon the subject.

He takes 1,200 as the horse-power of a modern high-speed locomotive, which can be had for about £2,000: this is equal to about 32 shillings per horse-power, and he shows how, to obtain this power on an electric train, there would be required:—

A 1,600 H.P. boiler at £3,200, a 1,600 H.P. engine at £3,600, a dynamo of 1,600 H.P. at £5,000, and a motor of 1,400 H.P. costing £4,400, a total of over £16,000 for motive power alone, quite apart from the cables and general outside electrical construction and buildings, all which are absent from steam railroads. The truth is that, as Mr. Westinghouse very clearly perceives, the steam locomotive is essentially a prime mover, and the electrical motor is not, nor is there anything actually in view at present that can be said to offer an immediate prospect of success to the electric locomotive.

An ordinary locomotive burns, we will say, 30 lbs. of coal per mile; many English express engines burn much less than this; 1½ tons will thus take the Flying Scotchman from London to Grantham, 105 miles, with fuel to spare. A large amount of water is required, and tenders hold this to the extent of 30,000 lbs., or more, and this requisite can be picked up on the road. Probably, somewhere about 50 tons may represent the weight of the boiler and its contents and the loaded tender, which go to make up the moving power requisites of a locomotive. Now, we may ask—is there an accumulator which, with its carriage, will not exceed 50 tons, and will give out for two hours the power to draw a fast train 105 miles, which is one of the longest continuous runs regularly performed by the steam locomotive? In this question, the plant to charge the accumulator is omitted, but nevertheless an accumulator would be a self-contained prime mover, in the sense that the energy in a lump of coal renders the present locomotive a prime mover. There are those who believe the future of electric traction to lie in the foregoing direction, but a glance at the shunting yard or gridiron of a large goods station is enough to daunt any advocate of electric traction, so far, at least, as regards general railroad work, and in the present state of our knowledge, we can hardly venture to idealise a centrally worked electrical line other than as a grand direct route between two large cities, unhampered by junctions or sidings; but such a line is not within the sphere of practical railroading. A satisfactory solution of the power storage problem would give us electric working at once on our main lines; but this would mean a cell capable of the heavy pounding it would get at high speeds, and this is not in sight yet.

To stop a 90 mile train in 30 seconds would be most excellent work, and in that time it would run nearly 2,000 feet, and oftener nearer 3,000 feet; but this question of brakes and stoppage is, to our mind, of far less weight than it appears to Mr. Westinghouse.

When it pays a railway to run a 90-mile speed, we can rely upon it that its signalling and general working arrangements will be such that the higher speed will be probably safer for passengers than the present 75 miles, which appears to be the running speed over portions of the Great Northern line to York. A rigid enforcement of a 20-mile block would, we might say, secure safety, and, how much less than this, signal engineers would tell us.

Tramways of limited extent have been and are worked on the conductor system, but there is an enormous difference between such a line and even the South Eastern, and it is useless blinking the fact that the problem of electric traction is at present very much further behind practical railroad success than was the steam locomotive in Hedley's day. Puffing Billy to-day more closely resembles a G. N. R. express engine than does any electrical system resemble what will, perhaps, some day perform G. N. duty, and this, we say, without any lack of faith in the future of electricity. Further, we might add, that the most serious

drawback to the fire-impelled locomotive, namely, the tunnel ventilation difficulty, is more nearly solved than is the problem of passing electrical energy from a conductor to a moving train upon a standard railway with its points, crossings, sidings, yards, and general intricacies. The field for electricity is already so great, and the general success which has attended electric lighting has been so encouraging, that we may well pause before forcing, or attempting to force, its application to other fields more quickly than natural developments warrant.

So long, too, as we depend upon coal to produce our electricity, we may be content to use steam locomotives, so far as mere fuel economy is concerned.

The loss between stationary engine and motor will go a long way to reducing the saving of fuel effected by a stationary engine of high class, and condensing, as compared with the locomotive of less economical performances. The problem of attaining 90 miles velocity is quite serious enough for us to leave the question of destroying the monster by brake power to those whom it will pay to raise it.

THE LIMITS OF TECHNICAL EDUCATION.

IN a most able address delivered at the opening meeting of the Mason College Engineering Society at Birmingham, Prof. R. H. Smith discussed at some length the great social question of "Technical Education: Its Use and Abuse: What it can do, and what it cannot do." He regards the aim of technical education to be the imparting of a knowledge of the practical and scientific facts; an understanding of the scientific and economic principles, and also skill in the use of the methods and appliances of some trade, industry, art, or profession. This, so far as these things can be taught by a teacher in a school furnished with the proper appliances for such teaching.

Prof. Smith expresses himself as very dissatisfied with the present system of school education. It is too narrow, too limited, and too unpractical for him. He wants to see fewer of words, books, figures and maps, and more of natural science taught. And he would add to this the instruction, in our schools, of manual work.

The importance of natural science in educating the mind and widening the range and sphere of thought, cannot be too greatly emphasised. Its effect has been witnessed by everybody who has cared to study and compare the thinking and working powers of the men about him. Huxley has gone so far as saying that "its influence has laid the foundation of a new morality," for in desiring to ascertain the laws of *comfort* we are driven to discover those of *conduct*. And the readiness with which the young mind receives the fairy tales of science is, no doubt, another indication of its fitness to form part of the curriculum of schools.

Yet we think that "reading, writing, figuring, grammar, history, and other *book*-study," notwithstanding the dissatisfaction expressed by Prof. Smith, must always hold its own in elementary education, and we fail to see how the teaching of manual labour can be taken into the general work of a general elementary school. For life is short, and the days of a school-boy are few, and if he does not peg away at "reading, writing, figuring, grammar, history, and other *book*-study" in the half-dozen or so years at school, he will have little chance of picking them up in the big world outside.

"How *can* we use words at all properly—grammatically or ungrammatically matters little—if we don't first of all understand accurately and know familiarly the things symbolised by them?" the professor asks. This is a fair question, and would seem greatly to favour a *practical* elementary or primary education; but we must not forget that without the aid of words it is impossible to follow an extended line of thought, and it is therefore impossible, but for words, to understand accurately, or know familiarly, anything much involved. This is why words stand so properly *first* in the education of men. With our hairy progenitors it was otherwise; but they didn't invent the calculus, nor even the bow-and-arrow.

Prof. Smith urges that the teaching of manual labour in primary schools might improve "the general social relations between the various classes in the nation; between employers and employed especially; between the genteel professional and the hard-handed artisan; between the finely-toiletted lady and her kitchenmaid, or her still more hardly-used dressmaker." He attributes "the hardness, the cruelty, the oppression that actually abounds in the complicated working of our modern society," to a want of intimate knowledge, by the one class, of the conditions of life in the other. It is undoubtedly true that much ignorance does exist as to the conditions of life in one class of society by the members of another, and that much advantage would result from a more extended knowledge of men by men. But it must not be thought that by learning a trade or profession at a school you experience the conditions of life under which the workers of that art or craft exist and struggle. A knowledge of the hardness, the cruelty, the oppression, is not to be arrived at otherwise than by going into the workshops and homes of the people. One might as well try to picture the terrors of war by a visit to Woolwich or Sandhurst, as attempt to realise the trials of an artisan by learning his trade at a "seminary for young gentlemen." And for the rest, is it not the fact that those are the hardest task-masters who have risen from the ranks, who have been through the mill, and have lost sympathy for others by the fierceness of the struggle?

It is, nevertheless, an excellent thing for a boy to learn the use of tools; it is a pastime rather than a study. He cuts his fingers, but he gets *practicability*, which is worth a few drops of blood.

Electro-Medical Terms.

AMONG the numerous papers read before the American Electro-Therapeutical Association at its recent meeting in New York, not the least important and useful was one by Mr. J. J. Carty, entitled "Medical Electricity from an Electrician's Standpoint." Therein attention was directed to the need for a thorough understanding of terms between electricians and physicians. Some of the words that have crept into electro-therapeutic literature were shown to possess little or no definite meaning, and even in some instances to be quite misleading, the undesirableness of such terms as "Faradism," "Galvanism," and "Franklinism," was pointed out, and a more clear understanding of "resistance" strongly recommended. In drawing attention to these points the author has done good service, for so long as these various "isms" hold their present place in standard works on "Medical Electricity," no true understanding of the physics of the subject can be imparted to the student perusing them, and while so little attention is paid to the resistance of the body or its parts, really accurate work in the treatment of the body by electricity is impossible. Mr. Carty also referred to the need for paying greater attention to the periodicity of inter-

rupted and alternating currents. The importance of this point was, we think, first shown before our own Institution of Electrical Engineers some two or three years ago, and since then it has been brought into greater prominence by the researches of Mr. Tesla and others. In view of the great influence periodicity has upon sensation, and the slow speed of the sensory nerve impulse in travelling to the brain as compared with that of electric impulses, it is manifest that much practical good may result from a careful investigation into the true relationship existing between different rates of frequency and the nervous system. This is the age of "nervous conditions." The hard struggle for existence and the high pressure under which most of us have to work, tells more upon the nerves than upon any other portion of our organism. May it not be possible to find an antidote in some soothing application of properly attuned electrical vibrations?

Irish's Thermo-Electric Arc Lamp.

IN another column we describe Mr. Irish's thermo-electric arc lamp, but we must confess that we have no great faith in this invention. The misnamed thermo-electric device probably will work, and if carbons are perfect and never had sudden changes of resistance when burning, probably the lamp would be as good as any ordinary pure shunt work which keeps constant P.D. on the arc, but as is well known, constant P.D. by itself will not do, we must have a second regulation by the current so that we have constant watts in the arc as well as constant, or nearly constant, P.D. This can only be done as is done in the Brockie-Pell—or any makers who use the combined action of the two windings—moreover, such action must be prompt to compensate for sudden changes in carbon above mentioned. We doubt whether Mr. Irish's lamp is sufficiently prompt; it does not provide for obtaining regularity in light when impure carbons are used, which is the aim of all modern improvements in arc lamps. The inventor's devices for burning long carbons by dispensing with rod and clutching carbon itself are as old as 1881, and don't work well unless the carbons are coppered, a process which is not liked in this country.

A Rival to Nickel-Plating by Electrolysis.

MR. LUDWIG MOND'S discoveries concerning the metallic carbonyls are a prominent feature in the researches of the past twelve months, especially his researches on nickel carbonyl. He has opened out the possibility of establishing a new industry which may prove a formidable rival to the industrial methods of nickel-plating by electrolysis. Nickel carbonyl is gaseous; its constitution is represented by the formula $Ni(CO)_4$. It burns with a bright luminous flame, metallic nickel separating and becoming incandescent. Solids heated in this gas to 200° C. become coated with bright metallic nickel, while carbon monoxide is liberated. It is very diamagnetic; its diamagnetic constant is $-3{\cdot}131 \times 10^{10}$, and according to Quincke it is an almost perfect non-conductor of electricity. All other compounds of nickel are paramagnetic. Its magnetic rotatory power is 38·21, which is, according to Perkin, greater than that of any other substance he has examined, except phosphorus. In other respects, too, nickel carbonyl appears to stand unique. Dr. Langer has constructed a complete plant on a small scale which has for a considerable time been at work extracting nickel from its ores by means of carbonic oxide, forming nickel carbonyl and then obtaining the metal by deposit. This plant is kept in motion by means of an electric motor. Plant to carry out the process on a large scale is now being erected in Birmingham. The advantages claimed are the great simplicity of the process, and the possibility of at once obtaining pure, firmly coherent, metallic nickel in any desired form, *e.g.*, tubes, copies of art-work by deposition in heated moulds, &c. It is in this latter advantage that the rocess is expected by its promoters to prove a serious rival to the present method of nickel-plating by electrolysis. In the course of a lecture given by Mr. Mond before the Royal Institution, he drew attention to the prospect opened out, of being able to meet the continually increasing demand for pure nickel; and, speaking of the valuable properties of nickel-steel, suggested that his process would become of national importance, since by means of it an abundant and cheap supply of nickel could be ensured.

A By-improvement in the Electro-metallurgic Production of Zinc.

ZINC has for some time been employed in the form of chips, grains, &c., with the object of purifying electrolytes containing zinc and used in the electro-metallurgical production of this metal. It has generally been recognised, however, that this treatment is by no means quite sufficient, hence there is room for a modification recently proposed by Nahnsen, in which the zinc is employed in the condition of powder. When rough zinc, or alloys of this metal, have to be refined and are used as anodes in the baths, the resulting lye is always neutral, or else slightly basic in character, and it is at once passed into purifying apparatus, which consists of flat vats, where it is treated with zinc powder, in order to free it from any impurities, after which treatment it is again ready for treatment in the baths. When the anode is of an insoluble nature, however, and the electrolyte consequently acid, it must first be neutralised by the addition of some ore containing the oxide or carbonate of zinc, or indeed any other material containing this metal in a readily soluble form, before it is passed to the purifiers. If the impurity is copper only, and amounts to 1 per cent. of the entire quantity of zinc, 10 lbs. of copper should be precipitated by means of zinc powder in the daily production of 1,000 lbs. of zinc; this will necessitate a daily addition of 11 lbs. of zinc powder. It is best, according to Nahnsen, to introduce at the beginning of the operation a larger quantity of zinc powder into each vat, say 100 lbs., and subsequently to add the amount required daily to the first of the series of vats in the purifying apparatus. Silver is sometimes present; if it exists in the proportion of 1 per cent. a daily addition of $5\frac{1}{3}$ ounces of zinc powder will be necessary for the proper treatment of the same output of zinc.

Ostwald on Energetics.

"ENERGETICS" is a term that is creeping into use to denote a sort of combination of kinematics and dynamics, the ideas of both motion and force being necessarily involved. Fresh interest has lately been aroused in this subject by a recent paper by W. Ostwald, in which he emphasises the fact that energy is the only magnitude common to all branches of physics, mass being confined, strictly speaking, to dynamics. Ostwald proposes that in an absolute system of measurement, mass should be replaced as a fundamental unit by energy, so that all physical magnitude should be expressed in terms of time, length and energy. The following table exhibits the dimensions of various magnitudes in the old and new systems:—

	Old units.	New units.
Energy	$[m\,l^2\,t^{-2}]$ ...	$[\varepsilon]$
Mass	$[m]$ ...	$[\varepsilon\,l^{-2}\,t^2]$
Momentum... ...	$[m\,l\,t^{-1}]$ ...	$[\varepsilon\,l^{-1}\,t]$
Force	$[m\,l\,t^{-2}]$ ...	$[\varepsilon\,l^{-1}]$
Surface tension ...	$[m\,t^{-2}]$ ...	$[\varepsilon\,l^{-2}]$
Pressure	$[m\,l^{-1}\,t^{-2}]$ ...	$[\varepsilon\,l^{-3}]$
Power	$[m\,l^2\,t^{-3}]$ ...	$[\varepsilon\,t^{-1}]$

Proceeding from the principle of virtual velocities, Ostwald arrives at the following general energy principle, which may, he says, be applied to all branches of physics and chemistry. In order that a system containing any forms of energy may be equilibrium, it is necessary and sufficient that for every displacement of the system consistent with its conditions of existence, the sum of the quantities of energy which appear and disappear should be zero. *Mass* is defined by Ostwald as "the capacity of an object for energy of motion;" whilst he rejects the substantial existence of matter.

ST. PANCRAS ELECTRICITY SUPPLY.

THE CHEAP DAYLIGHT SERVICE.

CONSIDERABLE interest has been aroused throughout the country by the expressed intention of the St. Pancras Vestry to carry out their managing engineer's scheme of giving a supply of electricity during the day for motive-power purposes at 3d. a unit, while lighting consumers would continue to pay 6d. per unit. The problem presented in this instance is but a phase of the general one towards which central station managers look with some expectation of future success.

The machinery which has to be laid down for supply purposes is fixed by the length of the greatest ordinate on the annual load curve plus a reasonable percentage of spare plant, while, on the other hand, the revenue is dependent upon the area enclosed by the load curve and the co-ordinate axes about which the curve is drawn. The great advantage, therefore, to a supply company of a class of customers who would fill up the valleys of the load diagram without materially raising the peaks, would permit of a lower rate of charge being made for the electricity so supplied to them; but to meet the provisions contained in the Model Orders, it would be best to treat these useful and advantageous customers as if they were paying the legal price per unit, subjected to a discount owing to the conditions imposed upon the supply so paid for. This line of reasoning led Mr. Baron to work out a practical system by which those customers who cared to submit to the rules and conditions imposed upon preferential supply could obtain electricity at a rebate of 50 per cent. for special purposes, and as the question has never been dealt with fully in the columns of a technical journal, we propose here to outline the method evolved by Mr. Baron for dealing with it. It is clear that whatever be the details of the apparatus used for controlling the supply, the governing conditions are, firstly, that the supply given under the rebate should only be available during the hours of light load on the system; secondly, that if such supply be desired after hours of light load, it should still be available, but charged for at the general price per unit ruling in the district. Thirdly, the means by which such transition is made must be automatic, cheap in first cost, and work practically without attention, as the profit on such supply would not allow of elaborate means of attaining the desired end. Fourthly, and lastly, in cases where lighting is electric, the supply for lighting purposes must all be charged at full price, whatever may be the case with the special supply given for power purposes. At first sight it appears to be a problem whose solution would hardly be worth while attempting, but by somewhat narrowing down the conditions it has been found to be possible to practically answer the question in the simplest manner.

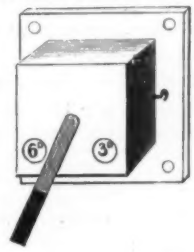
Taking into consideration the character and shape of an ordinary load curve of daily output, it will be seen that, under the first condition, the supply for power purposes could not be given or called a "day" supply, but only, correctly, a "daylight" supply.

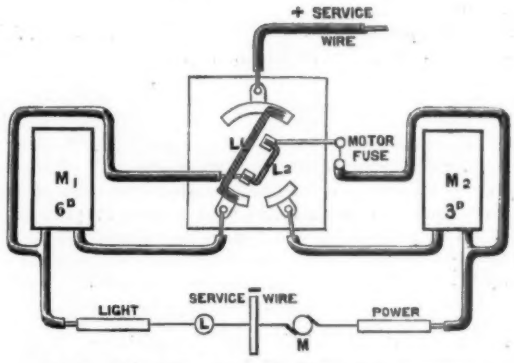
The combination of the second and fourth conditions have permitted of compliance with the third, and the mechanism required to make the necessary change has been supplied in the person of the consumer himself, by making the lighting of his premises dependent upon the motive power supply being taken at full price. Under these circumstances, we have the moral force which compels the consumer to pay 6d. a unit over all as soon as a heavy load comes upon the station, and motive power then pays as well as lighting.

As the vestry are quite prepared to give any consumer a supply under the Board of Trade rules which may be used for power purposes and charged at 6d. per unit, it is, in all respects, *intra vires* to offer a specially restricted supply for certain purposes which the vestry desire to encourage, and as a set off against the restrictions to offer a reduction of 50 per cent. on the supply so given.

The St. Pancras district has encouraged the vestry to become pioneers in this matter, as owing to the manufacturing operations carried on within its limits, and the system of supply being at the same time a three-wire continuous service, every facility was open for a trial of the scheme, which has proved so successful that it has become identified with the name of the vestry in the minds of the electrical profession throughout the country. The vestry do not bind themselves to supply under this scheme to any consumer, but only as they think fit, because on the interdependence of "light" and "power" in one consumer's premises lies the chance of success. At present, no attempt has been made to deal with consumers who use power only, but we believe that it is Mr. Baron's intention to meet this class by an automatic switch on the principle of a solstice clock. It has been very generally considered to be impracticable to so arrange the "day" supply at a lower rate, that, at least, in the winter months, the two curves would not overlap, and thereby cause the resultant profit from the special supply to be somewhat chimerical. By the adoption, as stated above, of a "daylight" in lieu of a "day" supply, this difficulty is got over, and, while giving the consumer the benefit of a cheap supply for his workshop during the major portion of the working day, places a remunerative load on the station circuits without entailing any considerable extra capital expenditure for plant or labour. It has been found that the addition of motors, so far, has not perceptibly raised the maximum load, although a benefit has accrued from the larger average out-

EXTERIOR VIEW OF SWITCH.





DIAGRAMMATIC PLAN OF SWITCHING ARRANGEMENT.

put due to the gradual extension of this system throughout the district at present served. The final design of the automatic, or, rather, semi-automatic, switch, used for the dual control of the lighting and power supply, is probably that shown in the cut, which represents the switch bars and their connections to the service and house wires. Although these switches have only been recently introduced, they have given such satisfaction that the present form, as made to Mr. Baron's designs by Messrs. Poole and White, will most likely be adopted permanently.

It will be seen that there are two positions of the switch handle respectively marked 6d. and 3d. Corresponding to these there are fixed meters, M_1 and M_2, the former integrating the energy to be charged at 6d. per unit, and the latter the supply to the motor, M, which is charged at 3d. Externally, the two positions of the handle show the rate at which the power supply will be charged, while internally a compound switch bar, having two separate contact levers, insulated from each other, but rigidly connected together, takes up the position given to it by the handle. The + service wire enters at the upper portion of the switch box, and is connected to the quadrantal contact in connection with the outer lever. This, when on the left hand bottom contact, causes the current to pass through the meter, M_1, which measures the current to be charged at the regular price of 6d. per unit. After passing the meter, the current splits up between the lamp circuit, L, and the power circuit, the path being through the smaller lever, L_2, through the motor fuse, and by another T-joint to the power terminals.

For the day supply of power the handle is reversed, when L_1 will connect the + service wire to M_2, disconnecting the

main lamp circuit and the smaller lever. It is in this position that the special supply is given at the reduced rate, and the vestry have arranged for a small number of lamps to be supplied in parallel with the motors where such lamps are incidental, or necessary to the work being done by the motor plants. The main lighting, however, can only be obtained when all the supply is paid for at the 6d. rate, and it is in this respect that the interests of the vestry have been safe-guarded.

The vestry, with their officers, Prof. Robinson and Mr. Baron, deserve all praise for the able manner in which the question of electric supply has been dealt with, and we are glad to note that the success obtained at St. Pancras has caused several other local authorities to view the question in such a manner, that hopes may be entertained of equally successful works in the districts under their control.

COMMERCIAL ELECTROLYSIS.

By EMILE ANDREOLI.

(Concluded from page 512.)

Electrolysis of Fused Soda.

Mr. Swinburne alludes to the Castner process, and adds, "Whether this process has had any success commercially, I do not know."

I can tell Mr. Swinburne that I had last year some price lists quoting the sodium manufactured by Castner at 1s. 8d. or 1s. 10d. per lb.; I may also say that this cheapness of sodium has greatly influenced the price of cyanide of potassium.

There was an old process, discovered in 1876 or 1877 by Eislenberger, which consisted in fusing dry ferro cyanide with sodium, but which, for many years, was rendered impracticable by the high price of sodium. Now, thanks to the cheapness of sodium, the manufacture of cyanide is a *fait accompli*. To return to what Mr. Swinburne calls the problems of Castner, I must say that I find very surprising that, a few lines after having declared that he knows nothing of the success of the sodium process, he says: "The price of sodium has been reduced recently by the Castner process, but the extraction of aluminium is still so expensive that electrical methods can compete."

Aluminium.

I am afraid Mr. Swinburne is mistaken when he affirms that aluminium cannot be extracted by ordinary methods. I am told that experiments are conducted at present in London for extracting aluminium from alkaline and earthy alkaline aluminates, and for the simultaneous production of hydroxides of the basic metals contained in the said aluminates; and it appears that the metal will be produced at a trifling price. Further, it has come to my knowledge that demonstrations will be made in this country before the end of this month of the production of aluminium by direct fusion of bauxite at a price of about 7d. or 8d. per lb. I am a strong partisan of electrolysis, but in some cases its advantages are nil, and I firmly believe that the electric production of aluminium cannot be a commercially paying industry.

There is no problem set in this chapter, but facts and figures only are given.

There are other points to which I might deal, to show how Mr. Swinburne is prejudiced and misleading in his views on the electro-metallurgy of aluminium.

Ozone.

I would never have expected that Ozone would be the object of one of the paragraphs of the "Problems of Commercial Electrolysis."

Ozone generated by silent discharges *is not* and *cannot* possibly be said to be produced electrolytically. Ozone by electrolysis is quite another thing, and we must no more allow Mr. Swinburne to assimilate the transformation of oxygen into ozone by electric effluvia to an electrolytic operation, than a few years ago the chemists allowed Mr. Fahrig to call ozone an electric gas.

Fused Salt.

This chapter is rather empty, as we cannot attach much importance to the statement that sodium could be used for "making aluminium, for amalgamation in gold extraction, and for making caustic soda by adding water."

Mr. Swinburne does not state on what authority we may grant that chloride of sodium boils a little above its melting point, and that melted salt is by no means a convenient substance to handle. This, however, is not an insurmountable problem, and if melted salt acts on fireclay crucibles, another material can easily be found.

He timidly advances that "it is said that chlorine will not attack a dry metal, so that iron can be used for the containing vessel." On this point I can assure him that it is so, and chlorine gas is currently sold in cast-iron cylinders.

"We now come to the anodes again!" he exclaims; "retort carbon is eaten away." Of course; it will be destroyed like arc lamp carbons, *ex nihilo nihil fit*, the only question is: Does it pay to use a destructible carbon anode to get sodium and chlorine?

It is discouraging to read this appreciation of the work of Jablochkoff, Rogers, Beketoff, Grabau, &c.: "So many workers have been unsuccessful with fused salt, that it looks as if there were some insuperable obstacle in the way, and it is questionable whether the ground is worth any future labour." If salt costs only 15s. per ton, as Mr. Swinburne puts it, he ought to be able to calculate the profit to be derived from this electrolysis of fused salt.

As Mr. Swinburne speaks of chloride of sodium boiling a little above its melting point, and of the formation of some sub-chlorides, which is the theory of Grabau, I am surprised that he neglects to tell us that last year Mr. Grabau was producing 100 kilos. of sodium per day, and is very possibly doing so now.

An electrician of his standing ought to speak respectfully of those who, in spite of their indefatigable researches, left the path open to progress, and the history of the induction coil, of Gaulard's secondary generator, and of the present transformers, must render him more indulgent for the pioneers of the electrolytic art, who did not reap what they had sown. But for Gaulard is it certain that we would now have the transformers which are now at our disposal?

Tin.

It is to be regretted that Mr. Swinburne does not say more on the recovery of tin from scraps, which, according to him, "can be readily effected." We should have expected to know from him what is the true problem of the separation of tin.

Mr. Swinburne informs us that he does not see how electrolysis can be employed to assist in cleaning plates before tinning, and that he has "examined one of the processes, and it was said to be working very successfully, but found the brushes had been accidentally left off the commutator."

If the brushes were not on the commutator, the only thing to do was to have them put on, so as to be able to form an opinion and to report on the electrolytic process, as compared with the chemical; and people who study the practical pickling of plates by electrolysis will not much appreciate the joke of the brushes. On this, as on many other points, it is impossible to agree with Mr. Swinburne.

We have improved almost to perfection our plant and machinery, said a tinplate manufacturer to me a little while ago; there is only one thing which we have not been able yet to modify; it is the cleaning of our plates. We still pickle them exactly as 40 years ago, and in the numerous works of Wales, we lose every day a large amount of money in consequence of the waste of acid and of the dissolved iron. We rely on electricity to remedy such a state of things, and I am sure electrolysis will allow us to pickle rapidly and cheaply our black plates. As for me, added the manufacturer, my works are not large, but still I calculate that every week I lose £17 of acid and good wrought annealed rolled iron, which is uselessly dissolved and goes to the river.

Electric Tanning.

Here at last we have a problem, as Mr. Swinburne declares "Electrical tanning, though it depends on electrolysis, differs materially from all the processes, in not depending on the isolation of radicles at the electrodes." And then he says: "If tannin is an electrolyte, it has a very complex molecule;" and later on, "If the skins are agitated, and electricity is passed, the agitation circulates the liquid into the interstices, and the electric current *sends the tannin through the walls* of the cells."

If so, is not tannin an electrolyte?

WEBSTER PURIFICATION OF SEWAGE.

It is difficult to understand how Mr. Swinburne has come to the conclusion that the Webster process for electrolytic purification of sewage is not on the same basis as the process found by Hermite (after Webster), for disinfecting ships and ports. Mr. Swinburne ought to know better, as the electrolysis of sewage water has been worked since the last few years, and reports and figures on the results obtained have been published.

This sewage process puzzles Mr. Swinburne, who gravely remarks: "There seems uncertainty as to what the action is supposed to be and why the solid particles should be influenced by the current." The Webster process has been worked long enough to deserve more than this passing criticism; but it looks as if Mr. Swinburne had not taken the trouble of enquiring about the working of any electrolytic process in existence, and simply compiled, commented, or summarised, the books of Watt and Gore, and the technical papers on the applications of electrolysis. In spite of what Mr. Swinburne affirms, the basis of the Webster process is that water and chlorides, which are always present in sewage, are split up into their constituent parts and produce a disinfecting liquid which is nothing more or less than hypochlorous acid, the most powerful known oxidising agent and an unstable compound, which, having delivered up its oxygen in oxidising organic matter, changes into hydrochloric acid which neutralises the alkalinity of the sewage. The hypochlorite of iron (his anodes are made of iron) is acted on by free ammonia, sodium, potassium, and magnesium hydrates, and the ferrous hydrated oxides precipitate the solid matters in suspension. This particular oxide of iron has the property of combining with organic matter and takes up more organic matter than if precipitated chemically. In the electrolytic process, the whole of the matter suspended is carried with the oxide of iron, together with a considerable portion of organic matters.

We all learnt this long ago, from Mr. Webster, himself and Mr. Swinburne forgot it, very likely, when writing that the Webster process is not based on the production of hypochlorite.

ELECTROMETALLURGY OF COPPER.

It is to be remarked that Mr. Swinburne, who devotes a great part of his paper to the description of the well known Marchese process, does not say a word about the deposition of copper, by Mr. J. W. Swan, at the rate of more than 100 amperes per square foot, and which one of the most prominent metallurgists and scientists not long ago called a National discovery.

This part of the "Problems of Commercial Electrolysis," and especially the paragraph on the cost of refining copper, reminds me of the chapter of the "Electrolytic Separation of Metals," by G. Gore, entitled "Cost of Electrolytic Refining." Mr. Swinburne is not complimentary to England when he says: "If a new process is brought out, it takes ages before it is taken up abroad and still longer before Englishmen will touch it." He ought not, however, to complain, since his Hedgehog transformer has not been long in existence, but is universally known and is applied in many installations in England.

Electricians will also find hard the sentence he passes on them when he says that "chemists are not generally electricians and electricians are seldom chemists."

WHITE LEAD.

"The improvement of the manufacture of white lead deserves the most careful attention," suggests Mr. Swinburne. "The Dutch process is unhealthy, costly, and barbarous."

Electro chemists have not waited for this warning to manufacture white lead by electricity, and to quote only one process, the electrolytic production of white lead has been in practical operation for two or three years in America by Turner Bottome.

GOLD AND SILVER.

The electro separation of gold and silver from their ores, by means of chlorine or other solvent, is not in such a backward state as Mr. Swinburne is inclined to make us believe: it is perhaps only a question of time to see it adopted in all the mining districts where sulphuric acid costs something like one shilling per pound, and the other agents for making chemically chlorine are proportionally expensive. *En passant*, I will say that Mr. Swinburne is not quite right when he criticises Mr. Crookes, who uses an alternating current for extracting gold. "Unless the current density of the electrolyte is somewhat fabulous," says he, "there can be no current in the small particles of gold." Mr. Swinburne forgets that Mr. Crookes has for object the treatment of refractory ores, and that sulphuretted ores are semi-conductive; and that the pulverised pyrites, agitated in a very weak salt solution constitute a fairly good electrolyte.

As regards his suggestion of "replacing Mr. Crookes' sodium amalgam by making the mercury itself the cathode;" this has already been applied to the metallurgy of gold. Since the last five years the electric amalgamators are all based on the use of a mercury cathode, and the one which is most known in this country is the B. Molloy apparatus.

Mr. Swinburne seems, however, to believe implicitly in the electrolytic recovery of gold, and to be afraid of seeing gold become a drug like brass or a base metal, as his last sentence, which was no doubt inspired by an economist, runs: "All improved processes for obtaining precious metals merely enrich some at the expense of others, and reduce the value of the metals. Obtaining gold more easily would be no good to the community unless it became cheap enough to be used commercially."

ELECTRIC FURNACE.

Properly speaking, this does not come within the scope of this paper," says Mr. Swinburne, "or there is no reason to suppose that *electrolysis has anything to do with the reduction of the oxides*,"

If so, why does he talk digressively about it in his paper on the "Problems of Commercial Electrolysis?"

The same can be said of his comments on the electrical manufacture of phosphorus by the Reademan, Parker, and Robinson process which he describes, although there is no more electrolysis in it than in the production of ozone by silent discharges.

CONCLUSION.

One would expect to find in the conclusion of this paper, which I have briefly reviewed chapter by chapter, the essence, the summing-up of the case of Commercial Electrolysis; but I must confess that Mr. Swinburne does not conclude anything at all.

There was no demand for such a superficial paper as has been given to the Institution of Electrical Engineers for the discussion of these Problems of Commercial Electrolysis. A scientific society or an academy is not an Areopagus of judges who may solve such or such commercial problems or difficulties, or declare that it is impossible to overcome them. Let Mr. Swinburne solve one of them and he will be welcome when he explains how it was done "commercially," and how he successfully overcame all obstacles; but as long as he has not done so, we hardly see what ground he has for asking the Institution of Electrical Engineers to discuss so widely the present known field of electrolysis.

Where is the electrician who would discuss with him so decisively the Problems of Applied Electro-chemistry? The *rôle* of prophet is a dangerous one; on the one hand it would be unfair to condemn the work of the pioneers of the electrolytic industry because they did not reach perfection at once in applying commercially electrolysis to different industries; on the other, if in the Institution of Electrical Engineers there are members who know that they can solve the problem of, for instance, the production of chlorine and caustic soda, or the economical and rapid electro-separation of metals from their ores, or have found a good unattackable anode, I am positive that they will keep their ideas for themselves and try to make, if not a "fortune," to use Mr. Swinburne's favourite expression, at least money out of their discovery.

We live in a time of inventions and patents, and the electrician who would facilitate the work of his colleagues and competitors, and prepare the way to others by giving publicly at present the explanations wanted for the discussion of the "Problems of Commercial Electrolysis," would be considered very unwise.

Mr. Swinburne has touched almost all the main subjects which are in the province of electrolysis, but this paper is not worthy of him. He has not said anything new; he has not suggested any new direction in the field of electro-

chemistry, and he has not laid down any problem at all which a scientific society might "well spend its time" in discussing.

It now remains with me to ask the readers to be indulgent for my faulty English, and Mr. Swinburne to accept my criticism in the spirit in which it was written. Would he have treated me more tenderly if I had attempted to write a paper on the "Problems of Commercial Transformers?"

WATER POWER.

By E. TREMLETT CARTER.

(*Concluded from page* 515.)

XII.

37. *Reaction Turbines continued.* — The velocity with which the jet issues from the reaction turbine is due to the virtual or relative head of water within the engine; and that head is equal to the sum of the actual head and the head due to the motion of the outlet point of the engine. Thus the relative velocity is—

$$v_r = \sqrt{2\,g\,H + v^2}.$$

In these engines the water is discharged in the opposite direction to the motion of the nozzle, so that the absolute velocity of discharge is—

$$v_a = \sqrt{(2\,g\,H + v^2)} - v.$$

To have a high efficiency this must be small, the efficiency becoming perfect when this is zero. The expression for the efficiency of these engines is—

$$\eta = 1 - \frac{g\,H}{2\,v^2}.$$

From which it will be seen that to have a high efficiency the velocity must be very high, and that perfect efficiency can only be obtained by running the engine at an infinite speed. Now, since at a high speed the losses due to friction are much higher than at a low speed, it follows that these engines cannot practically develop a very high efficiency. It is on this account that pure reaction engines are not commonly used. We shall not, therefore, consider any special type of reaction engine.

It will be seen that the phenomenon of reaction enters into the behaviour of all those turbines in which there is a head due to pressure within the vane spaces, and thus into the behaviour of those engines in which there is complete filling of the vane spaces. In the "Vortex" turbine one-half of the head is due to internal pressure, so that one-half of the work is done by virtue of reaction; and in most of the modern turbines which are used for electrical work the action is a combination of impulse and reaction.

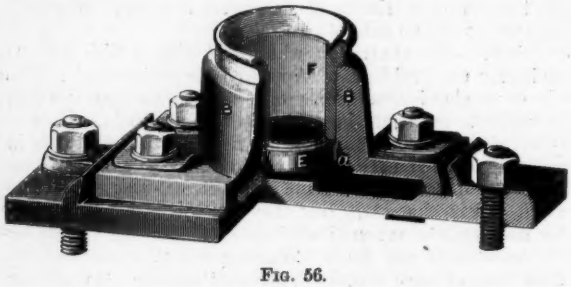


FIG. 56.

38. *Turbine Details.*—The bearings of turbine shafts are of the usual construction when worked dry and of special form when worked drowned. To the former the rules for engine bearings may be applied, additional care only being necessary to provide rings or collars sufficiently strong to take the severe end thrust which arises from the action of the discharge or the pressure of the impulse. In some cases these bearings are provided with a cavity connected with the head of water, the object being to prevent any leakage of air through the glands into the engine: any leakage which does occur will be of water outwards. Drowned bearings are usually constructed to support vertical shafts, and the bearing surface of the footstep is made of lignum vitæ, a hard, dense timber, which has a low coefficient of friction with metals when lubricated with water. Such bearings must be carefully housed, to protect the surfaces from grit, a light metal casing being usually provided. Fig. 56 shows a lignum vitæ footstep for a turbine. Under large heads the pressure on the bearing step is so great that timber bearing surfaces cannot well be used, in which cases the surfaces, E and F, will be of metal, lubricated with oil supplied under pressure through small pipes in the step box, B. Another method of reducing the pressure on the footsteps of engines under great heads is to supply the water upwards from the under part of the engine. This latter method is adopted at Niagara Falls, where the weight

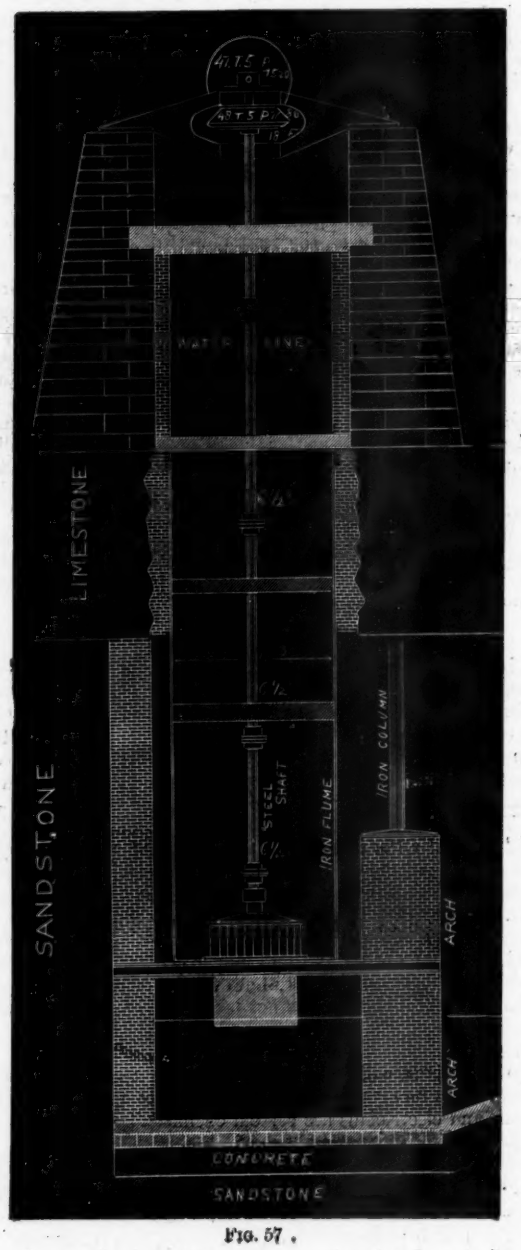


FIG. 57.

of the turbine and dynamo is taken off the step by the upward thrust of the head waters. The shafting for turbines is designed according to the usual rules for first motion shafting in which there is an uniform torque.

39. *Turbine Setting.*—This is a subject of such importance that a whole paper might well be devoted to it, but we can only spare space to consider a few essential details. The exact form of turbine setting which will be adopted in any case will depend on the type and size of engine, on the nature of the work to be done, and on the character of the mill site; and only the common sense and experience of the engineer can be a real guide in determining it. Wherever

possible, it will be advisable to adopt the horizontal setting of shafting, using a suction pipe to enable the engine to be put at a convenient height above the tail race. But this is not always possible; for, where the fall is large and the machinery to be driven cannot be placed at the bottom of the fall, as at Niagara, a long vertical shaft is necessary, and suction pipes would be of little use. A mode of setting employed in such cases is illustrated in fig. 57. Here, two 1,400 H.P. "Victor" turbines are working under a head of 50 feet, and are supplied with water from a wheel pit excavated in the natural rock and lined with brick. The engines are set in a flat floor supported on steel beams, which are built into the brickwork; and the water is discharged through arches at the bottom of the wheel pit. A good clearance of about 8 feet is given between the bottom of the engine and the floor of the pit, this being provided to permit of free flow from the engine into the tail race. It is important in all cases of turbine setting to deepen the tail race immediately beneath the engine; and the depth should be such that there is a mass of undisturbed water below the suction or discharge pipe. On low falls a depth of 2 or 3 feet is sufficient, and on higher falls increasing in proportion. It may be added that this deepening does not in any way deduct from the available head. In some cases guide cones are placed beneath the engine to guide the water smoothly away; but it is better to deepen the wheel pit. For the mode of setting turbines on low falls the reader is referred to figs. 39 and 45. Owing to the small clearance which is given between the guide blades and the vanes, it is necessary to set the shaft absolutely true; the engine frame must be set level so that the shaft is either horizontal or vertical, as the case may be, and this may be tested by turning the shaft round by hand to see if there is any grating noise caused by the vanes coming into contact with the guides. When properly set, the engine and its accessories should be securely anchored, for the weight of the parts is as nothing to the reactions which are set up when the engine is at work. If the supply pipe and the engine are not secured in such a manner that these reactions cannot cause displacement, a breakdown will probably occur, and some of the vanes or other parts will be damaged. On this account it is always more satisfactory to anchor the engine to steel or iron beams built into brickwork, rather than to the wooden staging or floor which is usually placed over the wheel pit. The foundation for turbines coupled direct to dynamos on horizontal shafting need not be very massive, as there is little or no vibration, and no rocking strains as in a steam engine.

(40). *Turbine Stations.*—Under this heading a few of the important electrical questions will be considered. One of the essential points of difference between a steam station and a water power station is the difference in temperature. Soon after a turbine station commences working there is, even in hot climates, a perceptible fall in temperature, and the air becomes chilly. Dynamo makers will, of course, take this into account in designing dynamos for such stations; and, as far as copper resistances are concerned, the effect is decidedly in their favour. But the fall in temperature is not on the whole advantageous, for the deposition of moisture on every available solid surface is injurious to the insulation of switches and fittings generally. On this account some water-power stations are provided with glass screens, separating the turbines from the dynamo room; but the main objection to this is the need of gearing when the machines are thus placed in a room apart from the engines. It is, of course, more efficient to have direct coupled machines, and it would seem that when once this dew effect is recognised there need be no very great difficulty in providing switches, &c., which will not be injured by it.

41. *Water Storage of Power.*—It has been proposed by Prof. Forbes to utilise a head of water to store energy in an electric power station in place of chemical storage cells. Pumping engines at full load are among the most efficient of steam engines, and water pumped to a high level cannot lose its stored energy, except by evaporation; so that this would seem to be a most efficient mode of storing that amount of energy which is necessary, on account of the variability of demand at an electric power station. The main question is involved in the prime cost of such a system of storage, and it is probable that this system would only be economical where there is, in the neighbourhood of the station, high ground to which the water could be pumped. This system is already in use at Geneva, although not for electric distribution of power. Water is pumped to a high level and stored in reservoirs to be supplied on a high pressure service for working turbines.

42. *Tidal Power.*—Attempts have already been made in certain favourable districts to utilise the energy stored in a mass of water raised to a high level by the tides. A very simple mathematical investigation is sufficient to show that the power available at any tidal mill depends on the square of the mean tidal rise and on the quantity of water stored. This being the case it follows that where the tidal rise is small the amount of land required for reservoirs will be very much greater than where the rise is great. In most cases the area of land necessary for this purpose is so considerable, and the price of land so high, that it would pay better to invest the money in a steam engine and buy coal. Only where land is cheap and coal dear, or where there is an abnormally high tidal rise, can this mode of obtaining power be commercially successful.

43. *Conclusion.*—In conclusion, we may observe that the question of utilising water power is one which will grow in importance as the means of transmitting the power to greater and greater distances become perfected, and as the price of coal and other fuel increases with their increasing scarcity. The invention of the electric transmission of power has given to this question a new meaning and a greater importance, by enormously widening the radius at which the power of a water site may be utilised. In water power there is a source of energy which is incapable of exhaustion, either from reckless waste or from abundant usage; a supply of power which, unlike that of coal, comes with the regularity of a government pension and which can as impossibly be anticipated. The men of this generation may waste the coal which should be kept for the next; but with water power it is impossible to-day to draw even on the supplies of to-morrow. "Men may come and men may go, but it goes on for ever." When we remember that the vast resources of Niagara are but a fraction of the available water power of the globe, and that the power of that single fall is greater than that of the entire annual coal consumption of the world at the present time, we are compelled to recognise the growing and immense importance of that source of useful power which these papers have imperfectly explained.

44. *Postscript.*—The author regrets that the patent nozzle regulator of Mr. C. L. Hett has been described and illustrated in fig. 50 as the Tweryk jet, whereas it is merely adapted to that turbine. The author desires to express his indebtedness to Messrs. F. Nell, G. Gilkes, W. Gunther, Fraser and Chalmers, and others, for permission to use their copyright illustrations in the sections on turbines.

THE INDUSTRIAL ACCUMULATOR.

IN an interesting article on the working of central stations publishing in *La Lumière Electrique*, M. G. Pellissier, speaking of the rendering of 87·5 per cent. of energy mentioned in No. 12 of *L'Industrie Electrique*, in reference to the Tudor accumulators installed in the electrical department of the Lyons Gas Company, adds that this rendering is excessively high. It has happened, in fact, that the capacity of the battery treated under these conditions has become slightly lessened at the end of some months. This is probably due to the fact that the chemical reactions at the end of the charge, as regards the deep layers, take place with difficulty.

In order to maintain the capacity of a battery, it is necessary to give an excessive charge, or, in other words, to prolong the intense bubbling for ten minutes. We can also decrease the current at the last, and prolong the charge during a longer period. In short, this amounts to sacrificing about 2·5 per cent. of the rendering, which is thus reduced to 85 per cent.

Rendering of Accumulators.—If we charge and discharge under normal conditions a battery of accumulators, utilising its practical capacity (charging at ·7 a. per kilogramme of plates, discharging at 1 a., and stopping the discharge when the electromotive force of the element is not more than 1·85 v.), we shall get a rendering in energy of 81 per cent. If the battery is charged normally and discharged at the mean output, which is half the normal output, we shall get 85 to 87 per cent. If the battery when fully charged is

discharged for a little while at a small output and then recharged, we shall get from 90 to 92 per cent.

Practically, *we can easily get the mean rendering of 85 per cent.* Even a battery that is not treated under the most favourable conditions will in all cases give a mean rendering above 80 per cent.

The Tudor accumulator keeps up this rendering indefinitely as the plates remain unchanged for a number of years.

Comparison between Accumulators with Grids and Accumulators with full Plates.—I have already maintained on several occasions the undeniable superiority in my opinion of the Tudor accumulator over the ordinary accumulators with grids. An accumulator with grids is soon destroyed (maximum duration, three years) through the following causes:—

1. Distortion and mechanical destruction of the plates in consequence of the swelling of the paste in the cells. If even the plates resist this action, their solidity is affected.

2. Imperfect contact between the cells and the partitions. The surface in contact becomes rapidly sulphated; the cells now hardly take part in the reactions, they begin to be useless and at last fall.

3. The fall of the paste. The gratings are partly emptied.

4. Sulphating in consequence of insufficient charges or local short circuits. We can only remedy this by overcharges which the cell accumulators cannot resist. Independently of this, it is necessary, as we have already shown, to overcharge the battery every day in order to maintain its capacity.

The cell accumulator can hardly stand this work. We are led to the conception of the Tudor accumulator by the following remark: When we examine attentively a plate with cells which has become completely deteriorated by several years' work, we can easily see that *the lead of the grating is scarcely oxidised.* The partitions are for the most part broken mechanically and the breaks are oxidised superficially, but we have only to make a section close to the break to see that the lead is intact.

Herein lies the superiority of the Tudor accumulator, which is really based on the fact that: "*In a full plate of lead oxidised superficially and kept in a state of oxidation in a bath of diluted sulphuric acid by means of an electric current, the oxidation penetrates with extreme slowness.* The superficial layers protect what is underneath.

I have before me an accumulator plate which has been in use for *eight years*; the layer resulting from the oxidation of the plate is not thicker than ·2 or ·3 millimetres. It is almost incredible, *but a fact nevertheless.* I deduce from this that the accumulator of the future will be composed of very thin plates of lead oxidised superficially. We know that the Tudor accumulator consists of full plates covered with horizontal furrows not very deep, filled with a paste of oxides of lead and acidulated water. These plates are formed as usual. After a little while the paste falls and there remains a plate oxidised over its whole surface.

We may say, therefore, that the accumulator begins by being a kind of Faure accumulator and ends as a Planté accumulator. We see consequently that:—

1. In an element thus constituted, we need not concern ourselves about the warping and destruction of the plates in consequence of the swelling of the paste. If the paste swells it comes out and eventually falls.

2. The defect resulting from imperfect contact between the paste and the plate need not be taken into consideration.

3. If the paste falls, we have shown that it in no way impedes the working of the accumulator when the plate presents a large oxidised surface.

4. If the plates are sulphated in consequence of local short-circuits or insufficient charges (the normal state of a battery is to be overcharged; we must therefore constantly restore a battery to its maximum charge and only stop it, if there is occasion to do so, in that state), we shall easily get rid of the sulphate by overcharges which will in no way affect the working of the Tudor accumulator. This apparatus can be with impunity subjected to most varied conditions of working, excesses of charge and discharge, bad manipulation, &c., and this is what really constitutes its industrial value.

In short, all we have to fear is the oxidation of the lead; and we have seen how slowly this takes place. The battery always maintains its high efficiency, because it remains unchanged during several years of service. It is far from being the same with the ordinary cell accumulators. In this latter case there is considerable loss of energy for the works, even when the battery is maintained by a company. If we add to this the inconvenience of incessant manipulation, we can easily understand the disfavour with which the accumulator is generally looked upon.

But these objections do not apply to the Tudor accumulator. The battery used for the last 28 months at the works of the Lyons Gas Company has not required any manipulation whatever. Every day it is fully recharged. The liquid that has evaporated is replaced by pure water, or water that is slightly acidulated, and this is all. It is easily cleaned once a year. The battery is absolutely in the same condition as when installed.

Employment of the Accumulator.—Security.—A battery may give out a current double and even treble of the normal current during a period long enough to provide for an extinction arising from some accident at the works.

This property enables us to ensure the reliability of a central station with a comparatively weak battery. We must only take care to make all the communications of sufficient section to conduct these abnormal currents, and to adopt a number of elements above the normal number in order to provide against the lowering of the tension.

2. *Regulation.*—Even a comparatively weak battery of accumulators is a wonderful regulator, enabling us to provide instantaneously against fluctuations arising from sudden variations of current (lighting or extinction on the system).

3. *Storage* and daily service in small works.

4. If we adopt a battery corresponding to one of the most powerful machines at the works, we can with perfect safety make *all the groups work at full charge*, by which means we effect a very considerable saving of carbon. In other words, only to set the machine going when the full charge can be realised, and then from that time during the whole time of the lighting, only to have groups on full charge, the battery ensuring the continuance of the service in case of accident to one of the groups. I call attention particularly to this last point as it is very important.

5. *Saving of Material.*—We may reduce to a minimum the reserve material, the battery ensuring security for some hours, which time is generally sufficient for repairs.

6. *Reduction of the Material.*—It often happens that the lighting undergoes a considerable increase during a comparatively short time, an hour and a half, for example. This leads us to adopt a generating power that is much higher (independently of reserve machines) than that which would be necessary for the mean requirements.

If we buy a machine of large output and feeble capacity, to be employed during the interval in question, and charged beforehand or afterwards, we shall effect a very important saving of material.

Practically it is easy to obtain a mean rendering of energy of 85 per cent. as a minimum, if the battery is well managed, and we get more than 80 per cent. even when this is not the case. In short, the essential difference between the cell accumulators and the Tudor accumulator, consists in the fact that in the cell accumulators we consider only the oxidised paste *from the point of view of capacity*, while the grating is almost disregarded, whereas in the Tudor accumulator we consider chiefly the oxidation of the plate, and trouble very little about the oxidised paste which only plays a provisional part.

We may here remark that the thinness of the layer of oxide must lead to a small capacity in the plate. The capacity of the Tudor accumulator is, in fact, somewhat small (and this is the one objection urged against it), but not so small as might at first be thought.

In fact, in accumulators in general, there is very imperfect utilisation of the paste, for the superficial layers are the only really active ones.

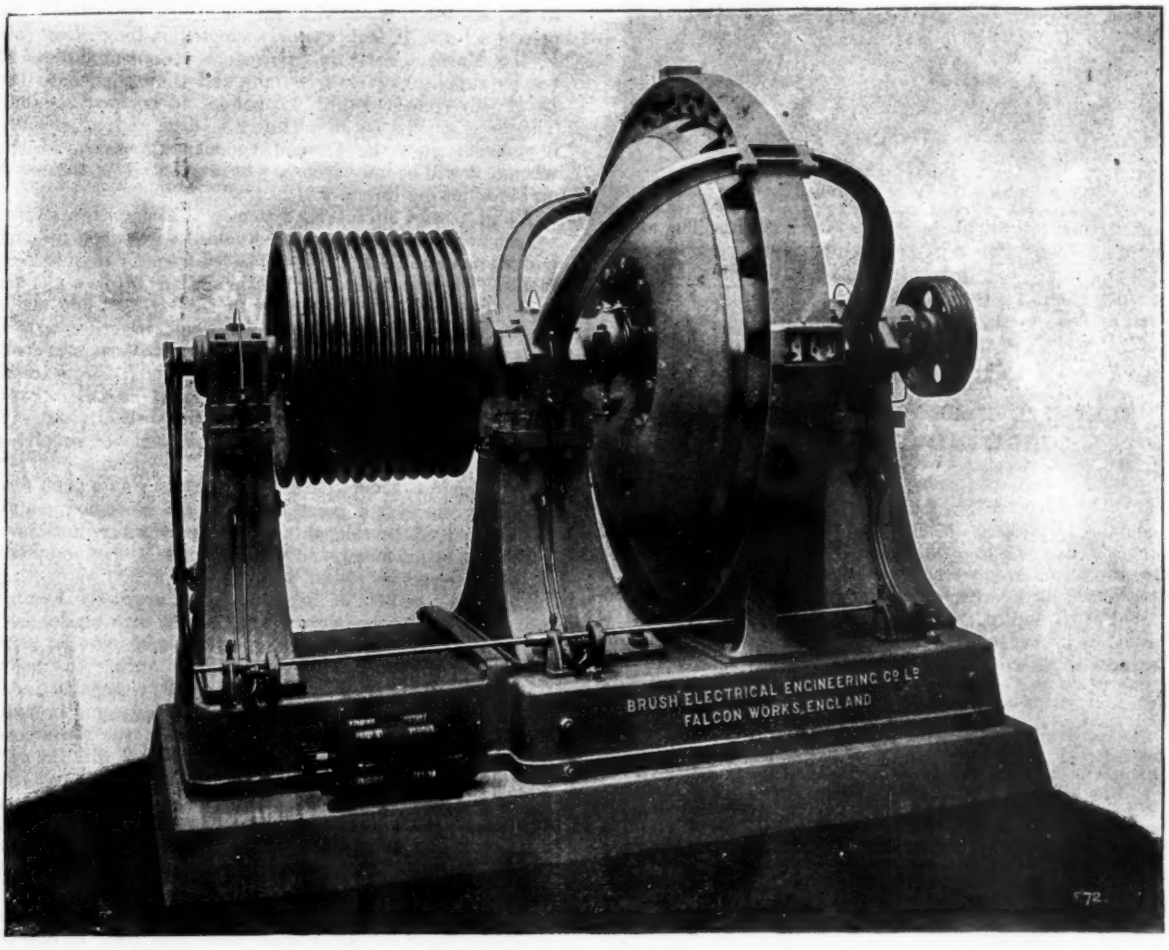
A Tudor accumulator containing 180 kilogrammes of plates 1 centimetre thick for the positives, has a capacity of 630 ampère hours, with a normal output of 160 a., and a régime of charge of 100 to 120 a.

We might reduce the thickness and increase the specific capacity. If, however, we compare the Tudor accumulator

with the cell accumulators from the point of view of the normal discharge current, and without regard to the capacity, we find that the Tudor accumulator (which lends itself perfectly to rapid discharges) is the best, pecuniarily speaking, for specific capacities of 4, 5, and 6 ampère hours per kilogramme of plates.

Now, rapidity of discharge is the most important point in central stations.

In this short article, writes M. P. Vitte in *L'Electricien*, I have constantly taken the Tudor accumulator as an example, simply because I have it at hand, to contrast with the old types of cell, or grid, accumulators, but I have no intention of condemning all types of accumulators that differ from the Tudor. Let the emulation of inventors furnish a really industrial type, and continuous currents will again compete successfully with alternating currents, to the great advantage of the progress of electrical industry.



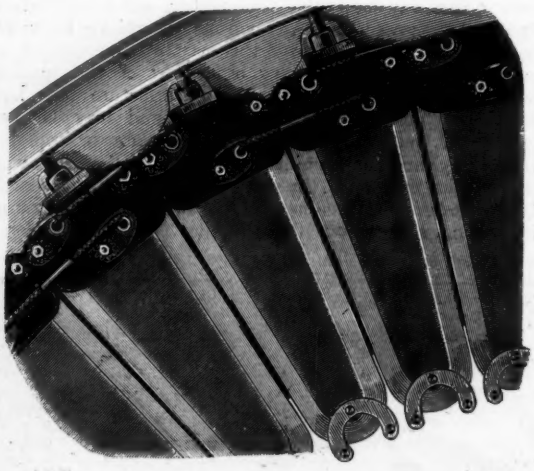
THE MORDEY 250 K.W. ALTERNATOR.

THE MORDEY 250 K.W. ALTERNATOR.

WE publish herewith an engraving, reproduced from the *Engineer*, showing the armature of the 250 k.w. Mordey alternator, which was exhibited by the Brush Electrical Engineering Company at the Crystal Palace Exhibition. We need not give particulars as to the general construction of the machine, as these will be sufficiently understood from the perspective view above. As regards output, in this particular case the following may be useful:—The armature is made for 2,000 volts, 250 k.w. = 330 E.H.P. at 100 periods per second. The speed of the revolving magnet is 300 revolutions per minute. There are 40 armature coils arranged in two parallels, with the terminals in the projections at the extremities of the horizontal diameter. The armature coils are each held between two German silver plates, embedded in ebonite, the ends of the coils being brought out through porcelain bushes. The holding plates are bolted together, with the coil between them, by three bolts, which are continued in one direction, and passed through three slotted holes in the inside flange of the supporting ring of the armature. By means of radial bolts in the same ring, the heads of which are placed in a recess of the coil plates, the coils will individually be forced down radially, the whole of the coils in that way supporting one another, and being radially fixed in a firm position. Any coil may be quickly taken out and replaced if necessary, and this may be done without removing the armature or any other part of the machine from its ordinary position. The armature is, however, split on its vertical diameter, and may be very readily put into its place on the bed-plate or removed. It can be cleaned or examined without removal. Even when the machine is at work, the whole of the armature is visible. In this respect the machine is unlike any other, it being usual in most cases to remove the armature or field, in order to carry out the necessary periodical cleaning and examination. The cores of the armature coils are of slate, round which the copper strip forming the armature conductor is wound. It will be seen that this construction, together with the use of a highly resisting alloy, like German silver, for the clamps, reduces to a minimum the losses in the machine—there is no iron to magnetise or demagnetise, and there is scarcely any metal in which eddy currents can be set up. The consequence is, that the machine not only returns a high proportion of the power given to it when fully loaded, but at light loads and on open circuit it absorbs very little power. This feature is valuable, not only because it reduces the heating, but because in electric lighting work it is often necessary to run at light loads, and it is equally important to have high efficiencies at light loads, which last many hours, as at full loads, which last for a comparatively short time.

The characteristic curve of the armature is nearly a straight

line, the difference between the volts at the terminals being only 4 per cent. to 5 per cent., with variations of load from nothing to the maximum, *i.e.*, if there were 8,000 8-candle lamps on the machine—its normal load—and all of them were suddenly switched off except one, that one lamp would not be injured. The volts would rise less than 5 per cent.,



unless the engine misbehaved itself and raced. The weight of the whole machine is 20 tons, the field magnet—the revolving part—weighing, with its shaft, 15 tons. The energy required to magnetise the field on open circuit is 1 per cent., and on full load 1¼ per cent.

LEWIS'S IMPROVED COUPLING FOR LIGHTNING CONDUCTORS.

IN this arrangement, the invention of Mr. J. Lewis, the coupling, instead of being made in two pieces as is usually the case, is made in a single piece (approximately of link or stirrup form), and having sockets at its upper and lower parts, the former being cylindrical and screw threaded for attachment of the top rod, while the latter is of flattened and of dovetail or wedge shape for retaining the tape, which is secured to the coupling by passing it through the socket and

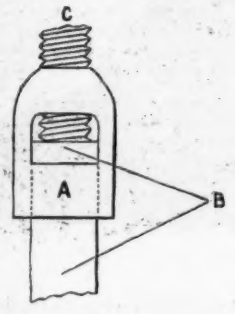


FIG. 1.

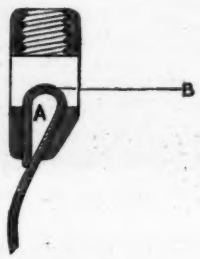


FIG. 2.

out laterally, and then doubling the end of the tape on itself, so that when the tape is drawn back its end is jammed in the socket, and it is effectually prevented from becoming detached; the strain on the tape assists materially in maintaining good contact.

Fig. 1 represents a side view of the improved coupling when in use. A is the dovetail or wedge-shape socket, B is the copper tape in position, C is the lower part of the top rod screwed into the cylindrical and screw-threaded socket through which it may be screwed down to and upon the copper tape, as represented in the drawing.

Fig. 2 represents a vertical section of the coupling, showing the copper tape, B, doubled over on itself, and drawn back and jammed in the dovetail or wedge-shape socket, A.

THE ELECTRIC LIGHTING AT PORTSMOUTH.

THE function of laying the foundation stone of the new central station at Portsmouth was performed on Thursday week by the Mayor (Alderman T. Scott Foster), in the presence of eminent townsmen and distinguished visitors. It rained the whole of the day; but a foundation stone laying, perhaps, after all, is best suited for a wet day. There is then no excuse to prolong what, under the best of circumstances, is a mournful ceremony. We do not in unkindness say that the dinner given by the Mayor in the evening created interest in a larger circle than the previous function. Nevertheless, it proved an agreeable opportunity for Councillor Ellis, the chairman of the electric light company, to give some information of what they proposed to do. Portsmouth people have been blamed—perhaps, not unjustly—for not sooner availing themselves of a better method of lighting, and, as a seaside resort, they may have suffered. But all propositions to use electricity met with the strongest opposition; the present scheme, in fact, was only adopted on the casting vote of the Mayor. Early in this year the Council decided to become suppliers of electric light, and they applied to the Local Government Board for powers to borrow £60,000. There was much delay in settling the loan, and it is but a few weeks since the Council commenced work. Of the scheme, it will be only necessary to say that it is somewhat on the following lines:—

A high tension alternating system, with a complete system of secondary mains throughout the whole districts where primary mains are carried, and which can be fed from the high tension mains. Carried from their central station will be a number of circuits, and side by side with the high tension mains would be a low tension main, which would never be wanted to carry more than 140 amperes, which was the maximum current they expected it to carry. These will be fed from transformers placed beneath the pavements in street boxes. Wherever there was a large customer who wished to use, say, 200 lights, a street box transformer, capable of supplying 500 lamps, would be placed opposite his premises. They would therefore avoid the necessity of carrying a great deal of the current over a great length of the secondary mains. They would not be obliged to put in transformers until consumers made a demand, and while ultimately they proposed that they should be placed at distances of 300 yards, they might at first be 600, or even 900 yards apart, the number to be increased as the demand arose. The high tension current would never enter the consumer's premises, so that great economy in power was ensured, especially during the hours of lighting, and the loss which they might reasonably incur would be less than one-third that in Newcastle and in other towns where the transformers were placed in the consumers' premises. New consumers could be connected with the current without interference with the supply to other parts of the same district, and in the event of a transformer breaking down, the light would not be interrupted, but the district would be supplied from the adjacent transformers, with but very little reduction of pressure. The mains would be able to carry 40 per cent. more current than they proposed to provide in the central station at present, so that they would be able, when the occasion arose, to increase their income by 40 per cent., without additional outlay. The high tension current would be conveyed at a pressure of 2,000 volts.

It is stated that the generating station will be, in some respects, similar to the one at Dublin, except that a Parson's turbo-generator will be used in addition to other machinery.

Electrical Standards.—A meeting of the Electrical Standards Committee was held at the Board of Trade on Thursday, October 27th. The committee discussed the report made to the British Association by the Electrical Standards Committee of the Association in August last, and considered the supplementary report they propose to make to the Board of Trade. The following members were present:—Sir Courtenay Boyle, K.C.B.; Major Cardew, R.E.; Mr. W. H. Preece, F.R.S.; Lord Kelvin, F.R.S.; Lord Rayleigh, F.R.S.; Prof. G. Carey Foster, F.R.S.; Mr. R. T. Glazebrook, F.R.S.; Dr. John Hopkinson, F.R.S.; Prof. W. E. Ayrton, F.R.S.

LEGAL.

THE THREE-WIRE SYSTEM.

DR. JOHN HOPKINSON *v.* THE ST. JAMES'S AND PALL MALL ELECTRIC LIGHT COMPANY, LIMITED.

SITTING in the Chancery Division of the High Court of Justice, on Wednesday, the 2nd inst., the trial of this action was commenced before Mr. Justice Romer. The plaintiff's case is that the defendants have infringed his letters patent, dated July 27th, 1882, and numbered 3,576, granted for the term of 14 years from the date thereof, the letters patent being for improvements in distributing electricity, and in apparatus to be employed for the purpose, whereof the plaintiff was the first and true inventor. The plaintiff alleges that the defendants have in their possessson, or under their control, apparatus and appliances made and arranged, and intended to be arranged, so as to infringe his patent. Accordingly, he (the plaintiff) claims:—An injunction; (2) damages, or an account of profits; (3) delivery up of infringing apparatus and appliances.

Stated shortly, the case for the defendants is a denial that they have infringed the plaintiff's patent as alleged; a denial that the plaintiff was the first and true inventor of the improvements he claims; an allegation that the letters patent are invalid.

Sir Richard Webster, Q.C., M.P., Mr. Aston, Q.C., Mr. Fletcher Moulton, Q.C., and Mr. Hopkinson, Q.C., are retained as counsel for the plaintiff; the defendant companies are represented by Sir Horace Davey, Q.C., Mr. Finlay, Q.C., and Mr. Roger Wallace. Messrs. Faithful and Owen, solicitors, of 11, Queen Victoria Street, Westminster, instruct counsel for the plaintiffs, while defendants' counsel are instructed by Mr. A. C. Curtis Hayward, of 27, Chancery Lane.

In opening the case, Sir RICHARD WEBSTER, Q.C., said that the action was for the infringement of letters patent granted to, and the invention being the invention of, Dr. John Hopkinson, who was not altogether unknown, judicially, to his Lordship. Dr. Hopkinson had appeared not unfrequently as a witness in scientific cases, a witness of great moderation and judgment with reference to the opinions he expressed. Wishing to make his statement as full and complete as though his Lordship had no personal acquaintance with the plaintiff's name, he (the Attorney-General) might add that Dr. Hopkinson was a gentleman of great scientific attainments, having been senior wrangler at the University of Cambridge—the labour to obtain which his Lordship would be able to appreciate—and having occupied a very distinguished position in the scientific world for many years. A great deal of his time and attention had been devoted to abstruse subjects, particularly to electricity in connection with electric lighting with all its modern developments. When the nature of the invention was explained, and when he (the learned counsel) indicated that the defence which was about to be set up was that there really was no invention in the matter at all, that all the important things were either obvious, or such as to fall within that class of cases in respect of which the Courts would not protect the patent, he was entitled to ask the Court to remember that the letters patent were not taken out by a casual inventor who thought of some idea and patented it for what it was worth, but by a gentleman of great experience and knowledge prior to the date of the particular invention in question. The invention related to electric lighting. The patent was now owned by the Westinghouse Company, who purchased it for a considerable sum; but the legal estate was in Dr. Hopkinson, and the action had to be brought in his name. The specification contained two very important inventions, only one of which had been infringed. Both parts of the patent were attacked, because, as the Court was aware, the person alleged to be an infringer was entitled to urge that the patent was bad by reason of the claim being too large in respect of the subject matter. Although that defence was not looked upon by the Courts with as much favour as other defences, they would have to deal with it. The important invention which had been infringed would be known by the name of "the three-wire system." It had to do with the electric lighting by incandescent lamps. With regard to the actual facts of infringement, there would be no substantial dispute. The defendants admitted that they had done what would come within the terms of the specification if the patent were valid; but, as usually happened, the question would turn upon the validity of the plaintiff's patent. They had to do with incandescent lighting of the character that illuminated the building they were in, the three main features of which were that there must be a source of electricity, conductors through which that electricity was conveyed to the point where it must be utilised, and motors or some other means of utilising the electricity when it was taken to the point at which it was to be used. They had here nothing to do with the source of the electricity or the lamps; the action related to an invention in the matter of the conductors, that was to say, the means whereby the electricity was taken from the generating station or source, and conveyed to the lamps where it was to be utilised. He was not aware that, at any rate of late years, any contest had arisen in the Courts relating to invention in this particular matter; but it was one of very vast importance, because one of the objections to commercially successful electric lighting was (until Dr. Hopkinson's invention) the great expense of copper in making sufficiently large conductors, in order to convey electricity successfully to the point at which it was to be used. With reference to observations that would be made as to the merit and novelty of the invention, he (the learned counsel) would be in a position to prove that this invention—most unquestionably remarkable and useful—overcame a difficulty which had been experienced by men of the greatest eminence in electric lighting for sometime prior to the enunciation of the invention of Dr. Hopkinson. It might also be mentioned that it was invented almost contemporaneously in America by Mr. Edison, who attempted to patent it in England, but found he was anticipated by Dr. Hopkinson. The same invention was subsequently discovered independently by a gentleman in England, who also thought he might patent it; but that gentleman found himself in the same position as Mr. Edison. The actual way in which the electricity was produced in order to supply the lamps was a matter immaterial for the purpose of the invention they were considering. The current leaving the generating station would be of a certain strength or pressure, and the word used to indicate electrically the pressure or potential of the current was "volt." In this case 100 volts would be referred to as the pressure at which the lamps were usually worked. In addition, there was a measure of quantity called an ampère. It did not matter what kind of lamp was used, except that it was an incandescent lamp, the patent having nothing to do with arc lighting. In arc lighting two points of carbon (or other conductor) were brought close together, and the electricity leapt across from one point to the other. In incandescent lighting a carbon conductor (generally in a vacuum) was raised to a high condition of incandescence, and the electricity passed through. The conductor was important. As a rule it was copper; a copper lead went away from one pole of the dynamo, and back to the other pole. When dealing with multiple incandescent lighting, that copper lead was not continuous, the actual connection being made with the lamps, which bridged across from conductor to conductor; so that, speaking commercially, if no lamps were on, no current would be flowing through the conductors, while, if two lamps were put across, a current of electricity flowed through the outgoing copper conductor, across as many bridges as were made for it by the lamps, and went back through the return conductor. The terms positive and negative had been used in connection with this return and flow of the current. By means of a beautifully constructed model, the learned counsel here explained the condition of things prior to Dr. Hopkinson's invention. He said that at the time when that gentleman first began to investigate this matter, electricians had been desirous of using lamps of high pressure or potential, but had been deterred by the difficulty and expense of having very large copper leads. They did, however, hit upon a device which got part of the way towards the invention Dr. Hopkinson made. The device he referred to was that of forming a bridge, but its result was to produce an unsteady light, the brilliancy of the lamps fluctuating with the change of pressure in the mains. Uniformity or equal pressure at each lamp was not secured; that was the problem which remained to be solved—a problem which (like others), when solved, seemed extremely easy, but which he should prove gentlemen of the greatest eminence could not see their way to clear up, though they had their hands on it, so to speak, until long after Dr. Hopkinson's invention. The invention consisted in taking a third wire from that point back to the dynamo, and in coupling up two dynamos in series, so that the middle lead should simply be required to take back the balance of the current, which was not provided for by the outside lead. [The learned counsel explained the three-wire system by means of the model, which worked admirably.] In Dr. Hopkinson's invention the important feature was that you only had to provide for the balance of electricity which went back through the ordinary return; and, secondly, that you had to take your lead in between the two dynamos. From the commercial point of view, it was perhaps as important an invention as any made since the incandescent lamp itself; because, copper being very expensive, it was an immense saving to be able to get that high voltage with an effective and steady light, whatever number of lamps were turned on. The specification said:—"My improvements principally relate to maintaining the electromotive force in a system of conductors for an electric supply at a fixed potential, but they also relate to reducing the cost of such conductors consistently with efficiency and safety." And, further on, "For the purpose of economising the cost of main conductors, I place two dynamo machines in series, and I place two systems of lamps or other appliances consuming electricity of approximately equal capacity also in series. A main conductor is taken from each extreme pole of the two dynamos, and a smaller conductor from between the two dynamos to points between the two systems of lamps, this intermediate conductor serving to bring back to the central station any electricity required for one system of lamps in excess of that required for the other system of lamps." On page 5, line 32, there was the following disclaimer:—"In order to combine the advantages of comparatively high potential in the feeding conductors, with lower potential in the houses in which the electricity is used, I make use of a system of three conductors in combination with two dynamo machines coupled in series." It would be seen that the combination involved two essential conditions: (1) that the two dynamos were to be put in series, that was to say, that you should have the excess voltage made up not by a lamp or more powerful machine, but by two machines thus coupled together; (2) that you balanced and arranged your consumers in either compartment on either side of the known conductor, so that what had to come back was the balance of electricity which was not got home by the ordinary means. It was a distinct return to the old system of flowing and returning, adding on what was necessary to provide for the difference of potential that had to be brought back. The defence with regard to this part of the invention was that: "The use of two dynamo machines, or one such machine, with independent circuits connected to only three main conductors, that is to say, having one terminal of each machine or circuit connected to a separate wire, and a third wire common to the two remaining terminals, was well known at the date of the said letters patent, and the alleged invention claimed in the second claiming clause added nothing requiring inventive skill to the stock of common knowledge existing at the date of the said letters patent." He would postpone any argument upon that until it was expanded by argument by his learned friends, or answered by evidence, simply telling his Lordship that, so far from it not requiring inventive skill, there had been more than one important installation, where, if this had been known, great

saving could have been made, and great advantages obtained. As a matter of fact, it never occurred to the most skilled people, and they passed away from it without the slightest idea that there was this possibility of making an effective system. There was no allegation of prior publication in any electrical book, description, or anything of that kind; but it was alleged that "In the autumn of 1880, and the beginning of 1881, the system described in the plaintiff's specification, and claimed in the second claiming clause, was publicly used for several months continuously by Messrs. Crompton & Co. at the Alexandra Palace, near London. They also used the same system publicly at the General Post Office at Glagow, in or about the year 1881." He must, with regard to that allegation, adopt the practice of waiting to hear whether the defendants succeeded in proving any such anticipation. Of course, if it were anticipated in that way, the patent would be bad; but, so far as he knew, there was no foundation for saying that this "three-wire system" was used or thought of in 1881 by Mr. Crompton It was then alleged that previously to the date of the said letters patent, several alternating machines, with independent circuits expressly for the purpose of such circuits being used in series in connection with three-main conductors and lamps arranged in the same way as described in the plaintiff's specification, were manufactured by Messrs. Siemens Brothers & Co. at their works near London, and sold in the United Kingdom. According to his instructions, the defendants would wholly fail to prove that anticipation. The particular instances of the prior user, upon which the defendants claimed to rely at the trial of the action, were the regulating devices used in the following arc lamps:—

(*a*) The Brush lamps made and sold by the Anglo-American Brush Electric Light Corporation in London, some of which were used at the South Kensington Museum in the year 1880, and onwards at the Great Eastern Railway Company's, Liverpood Street Station, in 1881, and onwards at the Crystal Palace Exhibition in the early part of 1882.

(*b*) The Crompton lamps made and sold by Messrs. Crompton and Co., at Chelmsford, some of which were used in the grounds of the Alexandra Palace, near London, in the year 1879; at Wimbledon, near London, in 1879; and at the Glasgow Exhibition in 1880.

(*c*) The Pilsen lamps made and sold by Messrs. Joel & Co., in London, in the year 1881, and onwards, some of which were publicly exhibited in May and June of that year, and also at the Smoke Abatement Exhibition, South Kensington, in the following autumn and winter.

(*d*) The Siemens differential lamps, made and sold by Messrs. Siemens Brothers & Co., at their works, near London, in the year 1879, and onwards, some of which were used in connection with the dynamo machines referred to in paragraph 13 at the dates therein mentioned.

Assuming the patent to be valid to the extent he had claimed for it, the defendants had admitted infringement, by their answers to interrogatories. In arc lighting the same number of ampères went through all the series of lamps that were on the circuit; in incandescent lighting exactly the converse took place—each lamp took its own proportion of the total flow of current which was being sent out. The next problem was a very important one, because, in his estimation, on it depended the understanding of the line of thought which led to Dr. Hopkinson's invention. The resistance of a given conductor of copper was a known quantity, but it was a very important thing when an increased current was going through the same sized copper wire that the rise or fall of the volume of the current should be known. A variety of means had been suggested and employed for indicating in the engine room what was the actual state of the potential or pressure at the consuming end. One of the devices was the bringing back of a pilot wire. The Court would be told, however, by gentlemen whose experience would not be contradicted by his learned friends or their witnesses, that these pilot wires were difficult to lay, difficult to keep in order, and frequently ineffective for the purpose desired. In addition, there was, of course, the expense of taking the wire out and keeping it intact. Dr. Hopkinson set to work to solve this problem by the use of old electrical expedients applied in a new way and for an entirely new object. He set to work to enable the engineer to read, or the engine to obey, what was the pressure at the distant end, so that the engineer would be able to tell in his engine room what was the pressure on these lamps if they were a mile away, or, if he thought fit to act automatically on the engines, that the actual alteration in the pressure should of itself turn on the steam current, or the current of electricity which should make the pressure constant. This object he achieved by means of a third standing wire in connection with a voltmeter. The learned counsel then read the description of the plaintiff's invention in the specification, frequently referring to the accompanying diagram. The plaintiff said that "to ascertain the potential at the far end of the conductor he made use of a galvanometer differentially wound with two coils, the one coil having a high resistance, as for measuring potential, and the other coil, of very low resistance, conveys the current to the main conductor, and acts in opposition to the high resistance coil. The differential coils may be wound on an electro-magnet, which acts as a relay to ring an electric bell, or to set in motion or to reverse a small dynamo machine, to adjust resistance, or control the speed of the steam engine, for the purpose of keeping the potential on service main conductors constant. An approximation to the same end may be attained by winding on the electro-magnets of the dynamo machines, in addition to the usual coils, whether in shunt, or conveying a current from a separate exciter, a few coils conveying the current to the main conductor, the effect of such coils being suitably adjusted." He respectfully cautioned his Lordship from using the knowledge of to-day in dealing with this patent, the whole problem being new at the time the patent was taken out. The very distribution of the current into minute fractions was comparatively young, while the parallel multiple system which had been started, had developed difficulties in the matter of conductors, and in the maintenance of a constant potential at a distance. His Lordship would remember this, and see that the principles that had been brought into play in connection with arc lighting would be a very small guide indeed. The defendants came there to say that it was not new to have a magnet actuated by a portion of the current. Dr. Hopkinson admitted that. But there had never been an instrument which would have the effect of indicating in the engineer's room the pressure at distant points of the main where a number of lamps met upon the parallel system. The plaintiff's invention was a new commercial instrument, achieving new results, and he (the learned counsel) knew of no case which could support the contention that it did not involve sufficient invention.

MR. JUSTICE ROMER: The patent has never been challenged before, has it?

SIR RICHARD WEBSTER said never. The defendants were fighting on behalf of a number of electric lighting companies, knowing it was worth their while to try and invalidate the plaintiff's patent. He (Sir Richard) had found the task of getting up the subject for the purpose of explaining it to the Court a singularly difficult one. He did not pretend to be an electrician, and the more he read with regard to electricity the less he knew about it. (Laughter.) He was told that the most learned men were driven to like straits. (Renewed laughter.) In conclusion, the learned counsel protested against the course pursued by the defendants in a recent case of taking the speech of counsel and asking witnesses whether they agreed with it or not. The case, he said, must be determined on the evidence of witnesses who did understand the component parts of the machine, and their operation in practice.

At this stage the Court adjourned for the day.

YESTERDAY, THURSDAY, NOVEMBER 3RD.

The hearing of this case was resumed before Mr. Justice Romer, with an application by Sir Horace Davey, Q.C., on behalf of the defendants, that he might be at liberty to amend the particulars of objection, or to give evidence relating to prior user not mentioned in the particulars of objection. The learned counsel said that what he proposed to give in evidence was covered by the general words in the particulars of objection, but he agreed that those general words ought to be made to relate to specific instances. Within the last few days the defendants had discovered that one of the lamps referred to in the paragraph relating to anticipations by Messrs. Siemens, was used by a gentleman named Joseph Davenport Andrews, who was once in the employ of Messrs. Siemens. The defendants wanted to add this instance to paragraph 13 of the particulars of objections.

SIR RICHARD opposed the application, except upon the terms of the defendants paying all the costs since the time when the particulars should have been delivered. The proposed evidence, he submitted, was inadmissible, because under the statutes the defendants were obliged to give the plaintiff the time and place of the alleged anticipation of the invention. There was no affidavit before the Court on which it could act.

After a short discussion,

MR. JUSTICE ROMER decided, with the consent of all parties, that the case should go on without prejudice to the evidence the defendants tendered. He would, he said, consider a proper affidavit in support of the admission of Mr. Andrew's evidence when such was prepared and presented, and, in the event of his deciding to admit the evidence, would allow any witnesses who might have been called to be re-called for the purpose of examination, or cross-examination, on the new matter.

SIR HORACE DAVEY, on the question of costs, said that if Sir Richard Webster, on seeing the new evidence, was so struck with the force of it that he abandoned his case, the defendants must, of course, pay the costs of the application; but if the case proceeded and the plaintiff was unsuccessful the contrary result must follow.

MR. JUSTICE ROMER reserved the costs of the application, and the evidence in support of the plaintiff's case was proceeded with, Dr. Hopkinson himself being the first witness.

DR. JOHN HOPKINSON, F.R.S., examined by SIR RICHARD WEBSTER, Q.C., said he had devoted his attention for a considerable number of years to the subject of electric lighting, taking seriously to the work about 1875. The first real discovery of incandescent lighting took place at the latter end of 1879. Up to that time electric lighting had always been carried out by means of arc lights, which were either single lights, or coupled in series. Speaking generally, in arc lighting the whole current went through the whole series, first through one and then through the others. There was no distribution of volume, the same amount of current going through each lamp in succession. When more lamps were put in the potential would require to be raised. In the case of incandescent lighting, where there were a number of lamps, the current was distributed between them in proportional parts for each lamp. When there was more than one lamp on the same bridge, or in the same series, the divided part of the current passed through each lamp of the series. In the case of a number of parallel bridges, each one consisting of one incandescent lamp, the pressure at each of these lamps must be the same. The object to be aimed at was to obtain constancy of current at the beginning of each bridge. The pressure, however, would be less as you got further away from the generating station, but there were several devices for getting over that difficulty. Feeding wires were led in at different points in the series, and in this way the deviation of pressure would be reduced very greatly. It was this difference of potential at lamps at a distance from the potential at the generating station which led him to devise his indicator, which was mentioned in the first claim. In multiple electric lighting it was necessary to maintain a constant difference of potential with a varying volume, and in arc lighting in series it was necessary to maintain a constant volume with a varying pressure. The advantage of using high voltage was

that you were able to light a given number of lamps with smaller conductors. That was a desideratum early found out by incandescent lighters. A diagram was put in showing several lamps in series, with a separate conductor for intermediate feeding, and the witness explained the operation of the system. In the first place, they were able to work at 200 instead of 100 volts, and when they did that they only had to carry half the current in order to get the same amount of energy, and consequently half the size of conductor would suffice. The object of the central wire was to enable each lamp to be turned off separately, without affecting the others in the circuit. An objection to this system was because the lighting on one side of the bridge would not be as bright as on the other, there not being enough current to bring the six lamps to their proper brightness. There was energy provided for eleven lamps connected in series, but the current had to be the same through five lamps on one side as through six on the other, so that you had either too much current on one side or too little on the other. Other diagrams were put in and a model, by means of which Dr. Hopkinson explained to his Lordship the operation of the different systems of incandescent lighting. Witness was aware of no user of the three-wire system for electric lighting prior to the date of his specification. Three wires had been used in duplex telegraphy, but that had no bearing on his invention. A third wire had also been used as a common return for two out-flows in electric lighting. There were certain disadvantages about this plan. When machines were used in series there would be a tendency to produce reversals of current and of the dynamos. It had been known since 1879 that two dynamos coupled in series tended to reverse each other. It was essential in his system that the dynamo should be placed in series. He had seen defendants' answers to interrogatories and had inspected their works, and he was of opinion that they carried out the three-wire system exactly as he described it. The aim of his improved voltmeter, as described in the specification, was to dispense with pilot wires, and to tell by the condition of the conductors what the pressure was at a given point. The letterpress and the drawings would enable a competent workman to construct his improved voltmeter, and there was no difficulty in applying the invention to alternating current machines.

Cross-examined by Sir HORACE DAVEY, Q.C.: The three-wire system was now sometimes used in arc lighting, but that was really only where it was in operation for incandescent lighting, and arc lighting was subsequently added. He did not think it was an advantage to apply it to arc lighting where arc lighting stood alone, though it might effect a certain economy of copper.

Some discussion took place as to whether certain passages in the specification were intended to refer to incandescent lighting, Sir HORACE DAVEY suggesting that there was no mention in the specification that the system was to be used with incandescent lamps. The witness was not sure that there was any specific mention of incandescent lighting, but pointed out that the diagrams clearly represented incandescent lamps.

In reply to his LORDSHIP, Dr. HOPKINSON said he contended that the application of the three-wire system to arc lighting would not be useful in comparison with other ways of doing the same work, although it would be useful as compared with an arrangement of arc lamps in parallel; but this latter method was not the way in which arc lamps were used. Witness did not see the installation of Mr. Crompton at the Alexandra Palace in 1880—81, nor had he been able to ascertain what the nature of that installation was. Sir Horace Davey submitted to witness a diagram, which he stated represented the installation mentioned. This showed a common return for two circuits from two dynamos, which were not arranged in series. This installation, as represented in the diagram, witness said did not anticipate his three-wire system, or come within his claim in any way. First of all, the lamps were arranged in parallel, and the machines were quite unsuited for working in parallel. If a person were to employ three wires in lighting two houses, or two rooms, it would not be within the scope of his invention if there were many lights in each house or each room arranged in parallel.

Cross-examination of Dr. JOHN HOPKINSON resumed: It did matter whether electricity were consumed by means of one big arc lamp or by means of a house lighted up by a number of incandescent lamps in parallel. With incandescent lamps one or more might be turned out and the others left lighting, and any desired proportion of the current consumed; whereas with the arc lamp all the current was consumed or none at all. If houses were substituted for arc lamps in the diagram put in, each house having a number of lamps consuming the same amount of current in the total as the arc lamp, the third wire would in that case be neutral. The two cases were the same in principle so far, that in both the middle wire was neutral and absolutely useless. It was only when a later stage was reached, and incandescent lamps were used that it was necessary to light up or turn out separately or in varying numbers, that the third wire became useful. The resistance of arc lamps varied, and it was very rare that two arc lamps worked in parallel with each other. If two lamps requiring, respectively, 50 and 48 ampères, were fed by 100 ampères of current, the third wire would serve as a relief wire, but would act injuriously on the light of the lamps.

Sir HORACE DAVEY: My witnesses do not agree with you; they say that it would be beneficial!

WITNESS, resuming, said: His system was worked in America with alternating machines. It was very difficult to run two alternating machines together, and it could only be done in series by putting both on the same axle, or rigidly connected together. There was no direction in his specification that alternating dynamos used in series with his system should have a rigid connection; it was common knowledge at that time that was necessary. It was subsequently found that connected in parallel they might control each other without a rigid connection. He could not say that there was any experience prior to the date of the specification of working alternating dynamos in series; but anyone endeavouring to work them in that way would certainly have them rigidly connected. Mr. Wylde, of Manchester, in 1869, described an experimental run of two alternating machines in parallel without being rigidly connected. But this paper appeared to have been forgotten until witness arrived, by somewhat abstruse considerations, that two alternating machines might regulate each other, when, having published his discovery, Mr. Wylde wrote to him informing him of his earlier experiment. Notwithstanding Mr. Wylde's paper, witness insisted that at the date of his specification anyone wishing to run two alternating machines together, either in parallel or in series, would certainly have them rigidly connected. In the installation in Inchigore, in Ireland, made by Messrs. Siemens, substantially there were two dynamo machines arranged in series. The system there in use did to some extent act in the same manner as witness's three-wire system, supposing there were a greater current passing on the one side than at the other, that current would be taken back by the middle wire. There was this difference, that whereas in this case the whole of the lights on one side would be turned out, whilst the others were burning, by his system a few on the one side only might be turned out, and the others left lighting. It would not be incorrect to describe the third wire in the case in Ireland as a relief wire; but his point was that the relief involved was undesirable. He was not aware of any place in this country where his regulator, without improvements, had ever been in operation. The combination of a shunt coil of fine wire, and a series coil of low resistance, which was an essential feature of his regulator, had been used for a totally different purpose by Abdank Abakanowicz. If witness used Abdank's method in the way described by Abdank, it would not answer his purpose; and if Abdank used witness's instrument in the way witness intended it to be used, it would not answer Abdank's purpose. Abdank obtained his motive or indicating power by the two wires being in a state of equilibrium at zero, whereas witness did not depend upon the large wire to counteract the attractive force of the thin wire. Then Abdank wanted to do something quite different from what witness contemplated. The former wanted to measure the variation in the resistance of an arc light.

Re-examined by Sir RICHARD WEBSTER, Q.C.: WITNESS was well acquainted with numerous apparatus with differential winding, and the specification of Abdank added nothing to his knowledge upon the subject. Abdank's specification would certainly not enable any person to construct the instrument which witness had described.

The Court then adjourned for the day.

NOTES.

Electricity in Newspaper Offices.—The Vienna *Fremdenblatt*, we understand, is now being printed by electricity, current being obtained from the mains of the International Electric Company.

Dundee Electric Lighting.—At a recent meeting of the Gas Commission Committee the question of supplying the electric light outside the compulsory area was discussed. The committee was informed that the Board of Trade had intimated that it could not sanction any expenditure for lighting outside the compulsory area.

An Instrument Wanted.—There seems, says *Industries*, to be no end to the disputes likely to arise between telephone and other electrical industries. In such cases one side finds the disturbance to be practically inaudible, while the other hears the roar of the dynamos and the throb of the engines as through an aural microscope. What is wanted is an instrument that will measure these minute alternating currents, and give definite readings in microampères. Matters could then be settled much more satisfactorily to both parties. Mr. Massey's method is to find how many handkerchiefs he can hear the disturbance through. This is better than nothing, but a definition is required of a standard handkerchief, as well as of the standard ear and pressure.

Fatal Accident.—An inquest was held at the Sussex County Hospital, Brighton, on Friday night, on the body of John George Willshire, aged 32, in the employ of the Brighton and Electric Light Company. He was at the works in Gloucester Road on Monday evening, when some waste got in the cogs of the machinery, and he put in his hand to get it out, when a thumb and a fore and middle finger were crushed. He went on very well at the hospital for 24 hours, after which acute delirium set in, and after a fit, which lasted two hours, he died. It was stated that the deceased had been in the employ of the Brighton and Hove Electric Lighting Company for more than nine months, and was a capable man. His act was purely voluntary. The jury returned a verdict of "Accidental death."

Electric Traction in Brussels.—The Brussels Tramway Company and a suburban railway concern having asked permission to adopt the overhead trolley system of electric traction, committees were appointed by the Ministry of the Interior and the Railway Ministry to consider these applications. Both committees, we understand, have reported favourably.

Australian Telegraphic Rates.—A Reuter's telegram, dated Brisbane, October 27th, states that the Queensland Government has resolved not to join the other Australian colonies in the guarantee to the Eastern Extension Telegraph Company, by virtue of which the rates to Great Britain are greatly reduced. The reasons given by the Government for this decision are that the guarantee is calculated to interfere with the completion of the Pacific cable, and assist a monopoly. In our "City Notes" will be found a report of Sir John Pender's remarks on this matter at the meeting of the Eastern Extension Telegraph Company on Wednesday.

The Lighting of the Thames Embankment.—An interesting report on this subject was brought up by the Highways Committee of the London County Council on Tuesday last. Four months ago the council sent a proposal to the committee to carry out, at a cost not exceeding £10,000, an electric installation, with the necessary plant for the lighting of the carriageway, footways, and parapet wall of the Victoria Embankment; and that the Highways Committee should also confer with the Bridges Committee and the Parks Committee respectively, and report whether the plant could be established on a sufficient scale to enable Westminster and Waterloo bridges and the Embankment gardens to be lighted from the same source. Upon the estimate being considered by the Finance Committee, the committee stated that doubt was expressed whether the Council could undertake the installation without first obtaining Parliamentary powers for the purpose, and also whether the Council had power to erect works on the land under the Charing Cross railway bridge, upon which land it was proposed to place the generating works in connection with the electric light installation. They had, at the request of the Finance Committee, carefully considered these points, and had taken the opinion of counsel upon them, and the result was that they had come to the conclusion that, in order to prevent any risk of the action of the Council in the matter being called into question, it was advisable that the Council should obtain Parliamentary powers to carry out the proposed installation. They recommended a resolution in those terms, which was agreed to.

Philotechnic Association, Electrical Section.—The reopening of the lectures in the electrical section of the Philotechnic Association, under the direction of M. Zetter, took place some days ago at the Ecole de Physique et de Chimie, 42, Rue Lhomond, Paris. These lectures are intended specially for constructors, employés, working electricians, and telegraph operators. The programme is as follows: Monday, 8.30 to 10, Linear Drawing, by M. L. Moreau; Tuesday, 8 to 9, *Industrial Electrometry*, by M. André Larnande, first year, *Lighting*. From 9 to 10, *Dynamo-electric Machines and their Applications*, by M. Langevin; preliminary studies, dynamo-electric machines, transformation, canalisation, distribution, utilisation. Wednesday, 8 to 9, *General Physics*, by M. Carchereaux; 9 to 10 *Telegraphy and Telephony*, by M. Naud. Thursday, 8.30 to 10, *Mineral Chemistry* (? inorganic chemistry) by M. P. Lebeau. Friday, 8 to 9, *Mathematics*, by M. Corlieu; 9 to 10, *Technology*, by M. E. Bonjeau. Saturday, 8 to 9, *Mechanics*, by M. Favier; 9 to 10, *General Electricity*, by M. Blavette.

Action against the City and South London Railway.—Yesterday, in the action of Pepperill *v.* the City and South London Railway Company, the plaintiff appealed to the Master of the Rolls and Lords Justices Lopes and Kay from a judgment of Mr. Justice Wills, who heard the case without a jury in May last. The cause for action, and other particulars, will be found in the ELECTRICAL REVIEW for May 27th last, page 680. The Master of the Rolls yesterday upheld Justice Wills's judgment, and dismissed the appeal.

New York Electrical Society.—The following course of lectures has been arranged by the managers of this Society for the coming season:—

1. The Arc Light (with experiments), by Mr. R. S. Dobbie.
2. The Telephone (experimental), by Mr. J. J. Carty, Electrician Metropolitan Telephone Company, New York City, and Mr. F. A. Pickernell, Engineer American Tel. and Tel. Company (Long Distance Company).
3. How to Lay Out and Wire an Isolated Lighting Plant, and How to Operate It, by Mr. August Noll, Superintendent New York Electric Equipment Company.
4. Primary Batteries (with exhibit of various batteries), by Mr. G. d'Infreville, late electrician Western Union Telegraph Company.
5. Electricity in Medicine (experimental), by Dr. William J. Morton.
6. The Progress of the Year, by Mr. Joseph Wetzler.
7. What Europe is Doing in Electricity, by Prof. F. B. Crocker.
8. The Magnetic Field, by Prof. E. J. Houston.
9. Insulation and Surface Leakage (with experiments), by Dr. J. B. Williams.
10. Electric Heating (with experiments).
11. The Storage Battery.
12. The Continuous Current Motor (with experiments).
13. The Alternating Current Motor (with exhibit).
14. Electric Railways.
15. The Incandescent Light.

The New Westinghouse Lamp.—The determination of the Westinghouse Company to supply its customers with incandescent lamps, alleged to be independent of the recently sustained Edison patents, has resulted, says the New York *Electrical Engineer*, in the construction of a lamp with a removable stopper. The adoption of a conical joint in place of the flat joint, early applied in the art, is, no doubt, the secret of its success.

Electric Lighting at Bowdon and Altrincham.—At meetings of the local boards interested, held last Monday, provisional agreements were come to with the Swan-Edison Company for the lighting of the whole district of Bowdon and Altrincham with the electric light. Powers will be taken for lighting both streets and houses.

Viscosity and Electrolytic Resistance.—The thermal variation of viscosity and of electrolytic resistance forms the subject of a short communication by Carl Barus to a recent issue of the American *Journal of Science*, the substance of which is as follows:—Experiments made on the effect of temperature (θ) on the viscosity (η) of a very viscous substance showed that $\log \eta_p$, $\theta = \log \eta_{po} - B\,\theta$ very fully reproduced the results. The subscripts give the quantities constant and variable; p denotes pressure, and B is constant. For napierian logarithms, absolute measure, degrees C., and marine glue, $\eta_{po} = 10^{2}$ and $B = 0{\cdot}379$. In other words, the rate at which viscosity decreases with temperature at θ° is proportional to the viscosity at θ°. Experiments made on the effect of temperature on the electrolytic resistance, r, of a silicate (diabase) within 1,500° C., showed that

$$\log (a + b\,r) = \log (a + b\,r_o) - b\,\theta,$$

very fully reproduced the results. Here a and b are constant, and a merely reflects the observational errors. For diabase, megohms and degrees C., $a = {\cdot}05$, $b = 0{\cdot}009$, $r_o = 318 \times 10^{6}$, napierian logarithms being taken. If a be eliminated, $b = 0{\cdot}010$. In any case, however, the rate at which electrolytic resistance decreases with temperature, at the temperature θ°, is proportional to the resistance at θ°. Hence viscosity and electrolytic resistance conform with the same law, and Carl Barus infers that a common kinetic principle underlies both. This may be stated thus:—The rate at which either configurational or molecular instability increases at the temperature, θ, is proportional to the instabilities present in the given volumes at that temperature—supposing that the number of unstable configurations, or of unstable molecules, respectively, is at all times small relative to the total number of configurations or molecules. Barus promises shortly to develop the thermo-electric equivalent, namely, $d\,\epsilon = A\,e\,d\,\theta$.

Insulation Resistance Tests.—As the subject of insulation resistance of installation work has been frequently alluded to in these columns, perhaps the results recently obtained at a large installation in the North may be of interest to some of the readers of the REVIEW. Leads to earth, 200 megohms per lamp. Returns to earth, 150 megohms per lamp. Leads to returns, 230 megohms per lamp. This is about 18 times greater than what is required by the Phœnix Fire Office regulations for low tension continuous current working. Tests were made with an Evershed ohmmeter, which was compared with a Wheatstone bridge, and found to agree.

Institution of Electrical Engineers.—An ordinary general meeting of the Institution is to be held at the Institution of Civil Engineers, 25, Great George Street, S.W., on Thursday next (10th inst.). The paper of Mr. James Swinburne, on "The Problems of Commercial Electrolysis," will be discussed.

A students' meeting will be held in the library of the Institution, at 28, Victoria Street, Westminster, on Friday, 11th inst., at 8 p.m., when two short papers will be read on subjects connected with the testing and calibration of electrical instruments.

We have often commented upon the management of the Editing Committee of the Institution, but we little thought into what an utterly undignified position it would eventually drift. The following letter, a copy of which has been sent also to our contemporaries, shows the Institution in the unique position of selling abstracts which the newspapers are to make for themselves:—"Dear Sirs,—Referring to my letter of May 27th last, I am now instructed to inform you that the council have made arrangements by which you can be supplied on the Saturday following each of our meetings with a type-written copy of the shorthand writer's report of the discussion at such meeting; upon the following conditions:—(1) That such copy be not printed by you in *extenso*, but only an abstract thereof in the third person; (2) That you pay to the Institution for being so supplied, at the rate of 10s. per column of printed matter so published by you."

Heckmondwike Electric Lighting.—The Electric Lighting Committee of the Heckmondwike Local Board have instructed the clerk to ascertain from several companies upon what terms they are prepared to put down an electric lighting plant at their own cost, and to supply the electric light, with power for the board to purchase the plant by agreement at the end of a term of years.

Fatal Accident at Bilbao.—A Reuter's telegram, dated Madrid, October 27th, states that a workman at the Nervion shipbuilding yards at Bilbao was carrying some sheet iron on his shoulders on 26th inst., when his load came in contact with an electric wire, through which a current was passing. The man was killed instantaneously.

The Electric Light at Guildhall.—At the Court of Common Council last week, on the recommendation of the Coal and Corn and Finance Committee, it was agreed that £1,750 should be contributed from the City's cash for the cost of installations, and £500 per annum for current and maintenance.

Brighton Electric Lighting.—At the Brighton Town Council's special meeting last Monday, resolutions were proposed extending the area of supply of electricity. The following interesting statement shows the number of lamps of 8-C.P. supplied from the Corporation mains on the last day of the months named in the statement:—

1891—September	1,632	lamps.
October	2,572	"
November	3,996	"
December	4,748	"
1892—January	4,980	"
February	5,372	"
March	6,074	"
April	6,118	"
May	6,376	"
June	6,844	"
July	7,374	"
August	7,516	"
September	9,348	"
October (15th)	10,248	"

Fire.—We hear that a large part of Messrs. Pulsford, Triquet & Co.'s lamp factory at Paris was burnt down some days ago. The repairing work is, however, being rapidly done.

Newport Electric Lighting.—On Friday last a sub-committee of the Newport Lighting and Traffic Committee proceeded to London for the purpose of making enquiries regarding the St. Pancras electric lighting installation.

North Brierley and Electric Lighting.—The North Brierley Local Board have appointed a committee to consider the question of lighting the district by electricity, and to report as to the advisability of applying for a provisional order.

Bradford Electric Lighting.—The Bradford Town Council have decided to make application for powers to borrow £30,000 for the extension of the electricity works at Bradford.

Buxton Electric Lighting.—A Committee of the Local Board has been formed to consider the matter of electric lighting for Buxton.

Warehouse Electric Lighting.—Some large drapery warehouse premises in Lower Sackville Street, Dublin—Messrs. Clery and Co.—have lately been fitted throughout with electric light. The installation consists of 18 1,000-C.P. Brockie-Pell arc lamps and 48 incandescent lamps, as follows:—12 32-C.P., 17 25-C.P., and 19 16-C.P.

Colchester Electric Lighting.—The Special Committee empowered to obtain a provisional order under the Electric Lighting Acts has been granted £300 to spend in the matter.

Brigend and Electric Lighting.—The Brigend Local Board, at a special meeting held last Friday, decided to obtain a provisional order, securing them the right of establishing a system of electric light in the town.

CONTRACTS OPEN AND CLOSED.

OPEN.

Derby.—November 10th. The Midland Railway, Derby, are inviting tenders for stores, and one of the items in the specifications is for telegraph instruments, wire, &c. The tenders, which must be addressed to the Secretary of the General Stores Committee, Midland Railway, Derby, have to be delivered by November 10th, certain.

Glasgow.—November 7th. For the supply of vulcanised India-rubber (form No. 14), copper and other wires and strand (form No. 33), for the Glasgow and South Western Railway. Particulars from the Store Manager, Kilmarnock.

Hove, Sussex.—November 18th. The Hove Commissioners are prepared to receive schemes, accompanied with plans, specification, and tender, for wiring the Hove Town Hall for electric lighting, and providing fittings and lamps. Latest date, November 18th. Further particulars will be found among our advertisements.

Huesca, Spain.—November 15th. For electric lighting of the town for a minimum period of 20 years. Particulars from the chief engineer, Orihuela Municipality, Alicante.

Hungary.—November 20th. For the supply of electrical conductors, etc., for the Kaschau-Oderberg Railway, Buda-Pesth. Particulars from the engineer.

Ireland.—November 21st. For the supply of brass and copper sheet, tube and wire, India-rubber goods and stores for the Great Northern Railway of Ireland. Particulars from the General Stores Depôt, Dundalk.

Paisley.—November 28th. The Paisley Town Council are inviting tenders from any company or person, for transference to them of the powers contained in the Paisley Electric Lighting Order, 1891. Copies of the order and information regarding the proposed site for central lighting station may be had on application, by appointment, to Mr. W. A. Bryson, M.I.E.E., 11, Bothwell Street, Glasgow. Latest date for receipt of tenders, November 28th. For further particulars see our advertisements.

Warrington.—December 3rd. The Cheshire Lines Committee are inviting tenders for stores, among other items being telegraph materials, instruments, wire, &c. Tenders must be delivered to the secretary, Mr. Glegge Thomas, Central Station, Liverpool, addressed Cheshire Lines Stores Department, Warrington, by December 3rd at latest.

BUSINESS NOTICES, &c.

The Electric Light in the City.—Since our last report quite a number of new contracts have been taken in hand or completed, among which we may mention one in the premises of the Sunday School Union, 57, Ludgate Hill, which has been carried out by Mr. A. H. Wood, of 39, Victoria Street, Westminster.—Messrs. E. L. Berry, Harrison & Co., of Lyric Chambers, Whitcomb Street, W.C., are fitting up the premises of Messrs. Salmon & Gluckstein, Cheapside, and also the premises of the London Stereoscopic and Photographic Company, Cheapside.—Messrs. Rashleigh Phipps & Dawson are engaged on fitting work at No. 80, Cornhill.—Messrs. Laing, Wharton and Down, are busy at 1, Fenchurch Buildings, Fenchurch Street; at Baltic Chambers, Bishopsgate Street; and in the premises of the National Life Insurance Company, King William Street.—The Brush Electrical Engineering Company are fitting up the Imperial Restaurant, Billiter Street, while Messrs. H. Binko and Co., of Leadenhall Street, have the contract for lighting the Yokohama Specie Bank, Bishopsgate Street.—Electric lighting work has also recently been completed in the premises of the Singer Manufacturing Company, Cheapside, Queen Anne's Restaurant, Cheapside, and in the premises of Mr. John Elkan, jeweller, 35, Liverpool Street. Messrs. McClellan and Co., of Ludgate Hill, have secured the contracts for lighting the following establishments:—Mr. Wood's premises, Cheapside (corner of Bow Church Yard); Messrs. Dollond's premises, 62, Old Broad Street; and the new building now in course of erection, 212, Strand.—We hear that the Electrical Supplies and Fittings Company, are at the present time busily engaged in the City. Among the numerous installations that they have on hand at the moment are the Alliance Marine & General Insurance Company, Capel Court; the Royal Insurance Company, Lombard Street; Liverpool and London, and London and Globe Insurance Company, Cornhill; Melchers, Runge & Company, Fenchurch Avenue; Ahrens & Company, Fenchurch Avenue; Farquharson, Roberts & Phillips, Upper Thames Street; McEwan & Company, Lombard Street, &c.

Private Electric Lighting at Dundee.—Messrs. William Hunter & Co., drapers, Dundee, having resolved to adopt electric lighting for their establishment, the contract has been secured by Messrs. A Macleod & Co., electrical engineers, of Glasgow and Dundee. The specifications provide for the use of the Edison-Swan incandescent lamp throughout the warehouse, and the installation will be of a very expensive character, and, so far, it is said, the largest in the city. Four of the largest windows are each to be lit with lamps of 200 C.P., and another four with lamps of 100 C.P. The doors at the street entrance will be illuminated by lamps of 100 C.P. The print, mantle, &c., departments, facing the streets, are to be lit with twenty-six lamps of 32 C.P., effectively distributed. A cluster of four 16-C.P. lamps is to be hung over the cash desk, which stands at the entrance to the back saloons. The spacious saloons themselves are specially adapted for effective lighting, and the intention is to make the most of the space placed at the disposal of the contractors. Several lamps of 200 C.P. and a large number of lamps of 32 and 16 C.P. will be distributed over the various sections. The fittings and lamp shades are to be of the best description, and advantage will be taken of the latest appliances.

The National Telephone Company and their Rents.—An action was brought last week in the Sheffield County Court by the National Telephone Company against George Bramhall, fishmonger and game dealer, Market Street, to recover £3 10s. for telephone rent. Mr. Styring appeared for the plaintiffs; and Mr. Howe for the defendant. A clerk of the company produced an agreement signed by defendant, which was made with the Exchange Company prior to the amalgamation of the two concerns. It appeared from this that the rent was £8 10s.; but it was stated that the company had voluntarily reduced the rent.—His honour said he supposed the company would not object to take the whole of the rent if desired. Mr. Howe said he was instructed that there was a verbal arrangement with Mr. Tasker that the defendant should be at liberty to terminate the agreement at any time without notice, and that when the companies amalgamated, as he had two telephones, he communicated with the plaintiffs, telling them to remove this telephone as he no longer required it.—The case was adjourned for Mr. Tasker to attend.

Leclanché Batteries.—Mr. R. Aylmer, of 47, Victoria Street, Westminster, S.W., informs us that Messrs. Leclanché & Co., of Paris, has appointed him sole concessionaire for the manufacture and sale, in Great Britain and the colonies, of their well-known primary batteries. We have also received a copy of Mr. Aylmer's illustrated descriptive price-list in which are full particulars of the most usual forms of these batteries. We specially notice the new Leclanché-Barbier patent cylindrical agglomerate batteries, of both the wet and dry types, which are nicely illustrated and particularised. These we understand are M. Leclanché's latest patent, and are now being introduced into this county for the first time. They are, however, it is stated, well-known abroad, where they are rapidly superseding all other forms of Leclanché batteries, as being by far the most efficient and economical cell yet produced. Messrs. Leclanché have accorded Mr. Aylmer the exclusive right of using their trade-mark on the batteries.

Mansion Electric Lighting.—A Perthshire mansion, Dunalistair, the residence of Mr. Bunten—has just been lighted throughout by electricity, water being the motive power. The dynamos are the Edison-Hopkinson patent, and were manufactured by Messrs. Mather & Platt. There are about 300 lamps fitted on the premises. Messrs. Mavor & Coulson, of Glasgow, fitted up the electric plant, while the turbines were supplied by Messrs. Gilkes & Co., of Kendal.

Catalogues.—We have received a copy of the United Electric Wire Company's latest catalogue. The book deals chiefly with wires and cables for electrical purposes. The first few pages contain particulars of weight, resistance and carrying capacity of copper conductors. Following this there are particulars and prices of silk and cotton covered wires for dynamos, transformers, &c.; platinoid wires for instruments, resistances, &c., copper conductors, flexible cords for telephones, bells, &c.; gutta-percha covered wires, electric light cables, and electric light leads. On page 23 a special feature is noticeable in what is headed "Wire price list ready reckoner;" this, we should think, will be very useful to electrical engineers.

A catalogue has been published by the Lithanode and General Company, of Millbank Street, Westminster. Details are included of the construction of Franklin-Lithanode cells, of which there are also several illustrations. Lithanode electric hand lamps, and Lithanode battteries for omnibus, tramcar and brougham lighting, and miners' lamps, form an interesting part of the pamphlet. There are also particulars of Lithanode batteries for domestic lighting, Lithanode testing cells, and batteries for stage lighting. The book is well got up, and, on the whole, exceedingly interesting and useful.

We have had sent to us a list of Messrs. Lud. Loewe & Company's new circular milling machines.

We have received from Mr. C. Cadle (whose name will be remembered in connection with windmill pumps) of Wellington Quay, Dublin, copies of some of his latest lists. One of these lists (a pamphlet of 30 pages) deals almost exclusively with the Cadle duplex jet water-wheel. Other lists describe and illustrate Cadle and Ridgway's patent "Double Perfection" turbine water-wheel.

Change of Address.—Mr. Philip S. Dyer, European agent of the Edison General Electric Company, of 34, Victoria Street, Westminster, states that on account of the recent consolidation between the Thomson-Houston Electric Company and the Edison General Electric Company of America (now called the General Electric Company of New York), the European business of the Edison General Electric Company will be transferred, on and after November 1st, to 7, Rue du Louvre, Paris, and the future business will be carried on from that office by Mr. E. Thurnauer, who, after that date, will represent in Europe the Edison General Electric Company, which company is part of the General Electric Company of New York.

We note that Messrs. Hodges & Todd have removed their works from 19, Kirby Street, to larger and more commodious premises at 32, Turnmill Street, E.C., and having considerably increased their plant and machinery they are now able to execute all orders for electrical measuring instruments, ammeters, voltmeters, &c., with promptitude and dispatch.

Scientific Electric Models.—A new list has just been issued by the General Electric Company, dealing with scientific electric models worked by dry batteries. The novelties, which are there illustrated, priced, and described, are intended for the Christmas market, and we believe there will be a large demand for them during the season. The following are some of the principal articles shown:—Model electro-motor with reversing switch; model lathe on baseboard with motor and switch; model dynamo or motor; model fountain on baseboard with electro-motor; model circular saw; model electrical workshop; model fan wheel. The list is a very interesting one, and we can confidently recommend these manufactures of the General Electric Company.

Electric Launches.—Messrs. Woodhouse & Rawson United, Limited, of the Strand Electric Launch Works, Chiswick, have just received an order from J. West, Esq., of the Albany, Piccadilly, for a handsomely finished electric launch, 35 feet in length, to be built in their best style, and to travel at a high rate of speed. The boat will be used entirely for pleasure purposes, and will add yet another to what is undoubtedly the best form of river locomotion. There is no doubt that the electric launch business is coming very rapidly to the front, and we understand that Messrs. Woodhouse & Rawson are constantly receiving an increasing number of enquiries from all parts of the world.

Electric Lighting of Mills at Newry.—We hear that Mr. Abraham Wilson, J.P., has lately had his extensive spinning mills in Newry fitted up with electric light. The mill is lit throughout with 220 Swan's incandescent lamps—those in the spinning and preparing rooms being of 16 candle-power, and those in the reeling rooms being of 25 candle-power. The light is giving great satisfaction. The electricity is generated by a Holmes "Castle" dynamo, and the motive power is supplied from the engine of the mill. The work has been carried out by Mr. George Coombe, of High Street, Belfast, electrical engineer, and it is expected several other mills in the town will soon be fitted up with the light.

The Brush Company's Works.—A few weeks back we had occasion to review a special issue of the *Manufacturers' Engineering and Export Journal*, in which was contained a lengthy, detailed, profusely illustrated, and well-printed description of the London and Loughborough works of the Brush Electrical Engineering Company, Limited, also a few of their manufactures. We have now received a copy of this article which has been reprinted from the *Manufacturer* in somewhat similar form.

Electric Accumulators in New York.—A short time ago, Mr. J. C. Howell, managing partner of the Llanelly Electric Lighting Company, secured an order from New York during his visit there, to supply his patent electric accumulators to the New York station, and several employés of the firm have now left for New York, to attend to work.

Novel Designs in Electric Fittings.—It is a common impression with those who have watched the development of the electrical industry in the past, that not so much attention has been given to the really artistic treatment of domestic fittings as might have been anticipated. With few exceptions the leading firms in the art metal manufacture have treated the new departure with neglect, if not with contempt. It is gratifying, therefore, to find that one of the most eminent firms in this line of business in Birmingham, has recently made special provision for meeting, in a comprehensive way, the demand in connection with the use of electricity in the home, for tasteful adornments in metal. A glance at a special list of their latest productions in art metal work, just issued by Messrs. Townshend and Co., of Birmingham, and of 62, Holborn Viaduct, London, or a

FIG. 1.

visit to their showrooms at the latter address gives the impression that, instead of working up old designs and adapting them to a new purpose, the manufacturers are starting on a new department of their business untramelled by old traditions, and with open mind for new ideas. We believe the firm is in a specially favoured position as regards its skilled staff, and that its French and English artists are exceptionally clever designers; it is, therefore, able to undertake the carrying out of specific work in any style to meet the wishes and tastes of architects, electrical engineers, or others having the responsibility of high class installations of either a public or private nature. Leaving over for a further notice the subject of electric light fittings, we give now a few illustrations of electric novelties specially worth

FIG. 2.

attention as showing the possibility of treating artistically such usually uninteresting objects as domestic bells and bell pushes. Fig. 1 represents a bell push which is made in polished brass, and is certainly an improvement upon the article now in common use.

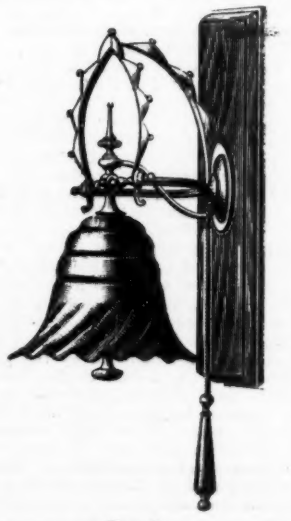


FIG. 3.

Fig. 2 is a polished brass electric bell for the table, complete with dry battery in the stand, and forming a bright and useful ornament. In fig. 3 is shown a hall dinner bell, also of polished brass, affixed to an oak board with pendant push. The gong shown in fig. 4 is wholly of brass, and contains a battery in the stand, which, with ordinary use, will last for several years. Another speciality of the firm in this way is an electric trumpet gong, giving a sound similar to a *cornet-a-vision*, or to a loud harmonium reed. The novel designs in the catalogue, to which reference has already been made, comprise electroliers, electric brackets, girandoles, piano sconces, pushes, toilet glasses, music stands, table and floor lamps, as well as bells, gongs, &c.

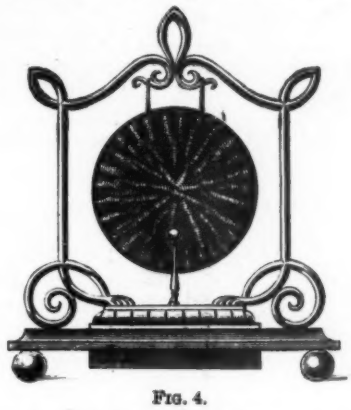


FIG. 4.

Dealers in fittings would find most of the articles enumerated very attractive in a window or showroom, and many of them very appropriat efor Christmas presents.

The Electric Light in South London.—Since our last report progress has been made as regards the adoption of electric lighting in this district. Among the new work in hand we notice that Messrs. Marryat, Lillywhite & Co., of Dashwood House, Broad Street, E.C., are fitting up the premises of Mr. Wm. Hurlock, 33 to 41, Walworth Road, Elephant and Castle.—Electric lighting work is also being completed at No. 220, Westminster Bridge Road, by Messrs. Mather Brothers, of Charles Street, Hatton Garden, E.C. The Canterbury Music Hall, in Westminster Bridge Road, is also being fitted with electric light, the contract being in the hands of Messrs. F. Suter & Co.—Mr. W. Winn, of Union Street, Borough, S.E., has recently carried out a contract for lighting the new premises of the "Prince William Henry" Hotel, in Blackfriars Road.

Lancaster Electric Lighting.—At the monthly meeting of the Lancaster Town Council last week, the report of the Lighting Committee, who have been making enquiries as to the lighting of the streets of the borough with electricity, after visiting various installations in different parts of the country, they unanimously came to the conclusion that the "low tension system," would be the best adapted for Lancaster. They recommended that the Brush Electrical Engineering Company, Limited, Messrs. Crompton & Co., Limited, and Messrs. Mather & Platt be invited to furnish the Corporation with a complete scheme and detailed specification for the electric lighting of the borough, together with estimates of the cost at which they would be prepared to carry out such a scheme.

House Lighting by Electricity.—Mr. Angelo Fahie, who, as we announced in our last issue, is bringing out a book treating with the matter of domestic electric lighting, asks us to state that his attention has been called to the similarity of his intended title, "Household Electric Lighting," to that of Mr. Segundo's book, "Domestic Electric Lighting," issued last week, and he has therefore altered his title to "House Lighting by Electricity."

Presentation to an Engineer.—Mr. Howard Tasker, M.I.E.E., an engineer identified with the progress of electric lighting in Chelsea, chief electrician to the Chelsea Electricity Supply Company for some years, has, we understand, recently severed his connection with the local company, and on the occasion of his departure he was presented with a suitable and valuable souvenir by the employés of the company as a mark of their esteem and appreciation.

Correction.—In our reference last week to the electric organ to be erected at a Gilston church, an error arose in heading our notice. Instead of our stating "Electric Organ Blowing," we should have said "An Electric Organ," as we have since been informed by Messrs. Bedwell & Son that the organ is not *blown* by electric power but is *played* by electricity, having the keys and pedals some 80 feet from the organ. At present it is blown by manual power.

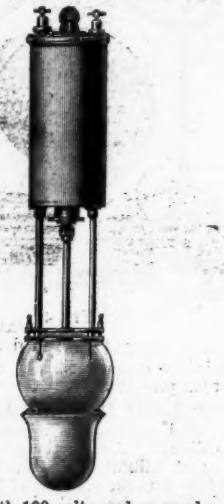
Australian Train Lighting.—We hear that the Railway Commissioners have recently entered into an agreement with the Brush Electrical Engineering Company to run for six months on the South Australian railways, a train fitted with the electric light. The inaugural trip of the train was made in September.

Dissolution of Partnership.—The dissolution of partnership of Messrs. Rashleigh Phipps and Dawson, has been effected as from Friday last. Mr. Phipps, trading as Messrs. Rashleigh Phipps & Co., we understand will carry on electric wiring and fittings business at 102, Oxford Street, where all communications should be addressed.

"Johnstone," System of Conduits.—We hear that the City of London Electric Lighting Company intend laying some of the "Johnstone," system of conduits (International Electric Subway Company's patent) for telephone cables, and the work will shortly be commenced in John Carpenter Street, Blackfriars.

Personal.—We are informed that Mr. Crompton has resigned his position as consulting engineer to the York Corporation in reference to the electric lighting scheme, in order that his company may be at liberty to tender for the work.

New Type of "Brockie-Pell" Arc Lamp.—Messrs. Johnson & Phillips have recently brought out a new type of the Brockie-Pell arc lamp. This lamp, which is focussing, has been specially designed for use in shop windows and other indoor positions where little space is available. It gives a perfectly steady light with either continuous or alternating currents of 5 to 10 ampères under any of the following conditions, viz.: In parallel with 50 volts and



upwards; two in series with 100 volts and upwards; any number in series. The illustration above shows the lamp on a scale of about one inch to the foot. We understand that the first 50 lamps of this kind are in use at Messrs. Jones Bros., whose new and extensive premises at Holloway have recently been fitted up by Messrs. Sharp and Kent exclusively with arc lamps, and the establishment is said to be one of the best lighted in the United Kingdom.

CITY NOTES.

Montevideo Telephone Company.

THE annual general meeting of this company was held at the offices, 96, Gresham House, Old Broad Street, E.C., on Monday last, Mr. Herbert Ward presiding.

The SECRETARY (Mr. E. M. Reiss) having read the notice convening the meeting,

The CHAIRMAN said that the directors' report and accounts had been duly circulated, and he presumed they might take it as read. With reference to the second paragraph, he would call their attention to the fact that during the last business year, ending July 31st, they had realised an increase of profit over the previous year, equal to 1½ per cent. of their preference capital. That was entirely due to economy and management. Mr. E. F. Powers had resigned his post as managing director, which had resulted in a considerable saving. It was the earnest desire of the board to strengthen the company's position in Montevideo, and in order to do that they had adopted a new plan. According to the new system, they paid each person employed in answering calls, according to the number of calls answered by them. Thus each assistant had an individual interest in the welfare of the company. It was apparent that the attentive *employé* was most successful, and the natural consequence was, that all the assistants were on the alert. Should it be possible to make any further reduction in expenses at Montevideo, no efforts would be spared to do so, although at the same time he must frankly say that he thought the expenses there had reached their minimum. Regarding the purchase of the buildings at Montevideo referred to in paragraph 3 of the report, he would assure them that that step had been taken only after most mature consideration. The gist of their situation was this—they had earned a dividend to expend the money in purchasing their offices. They were very much opposed to that purchase at first, and they tried to persuade the owner to come to some other agreement; such negotiations went on for six months, and it ended in his saying, "You will pay me my price for the buildings or move." Therefore as they could not move because of the enormous expense, and the possibility of losing subscribers, they bought the building. They had now just received a telegram stating with advices from the manager, informing them that the lower portion of the buildings had been let at £254 per annum. In April last, he (the chairman) took the opportunity of visiting Montevideo in order to see the district offices, and interviewed their officials, and, as a result of his investigations, he was glad to be able to report most favourably upon the orderly management that prevailed, and also upon the general condition of the company's property. As they were doubtless aware, affairs in Montevideo were still in a most unsatisfactory condition, and bearing that in mind, he thought the shareholders ought to be well satisfied with the report presented to them. If they continued to do as well in proportion, their position would be a highly satisfactory one. It was the object of the board to have a sound 6 per cent. paying preference stock, which they hoped to have by their next year's meeting. He then moved the adoption of the report and accounts.

Mr. C. H. SANDFORD seconded the motion.

After a brief discussion, in which Messrs. Praed and Lock and others took part, the chairman's motion was amended, and he moved that the report and accounts be received and adopted with the following addenda:—

"That a dividend at the rate of 3 per cent. per annum be declared on the preference shares of the company, such dividend to be not immediately payable, and that a committee be formed to confer with the directors as to the best way of carrying out or securing payment."

This motion was then carried unanimously, and it was agreed that the committee consist of Messrs. Praed, Lock, Toot and Kallick.

Mr. SANDFORD was next re-elected a director of the company.

The auditors, Messrs. Gérard Van de Linde & Son, were re-elected, at a remuneration of 20 guineas.

A vote of thanks to the chairman and directors terminated the proceedings.

The Eastern Extension, Australasia and China Telegraph Company.

THE thirty-eighth ordinary general meeting of this company was held on Wednesday (2nd inst.) at Winchester House, Old Broad Street, Sir John Pender, G.C.M.G., M.P., presiding.

The SECRETARY (Mr. F. E. Hesse) having read the notice convening the meeting, also the minutes of the previous meeting,

The CHAIRMAN said he presumed they would take the report as read. He would, as usual, give them some details which would more or less clear up some of the points in the report, although the report in itself was very full and complete. The gross receipts for the half-year under review had amounted to £246,988 against £264,878 for the corresponding period of 1891, showing a decrease of £17,890, of which over £8,000 was due to loss on exchange, and the balance to the reduced rates with Australia. It was, however, proposed, at the request of the colonies, to shortly raise the rates to Australia by 9d. per word, so as to diminish the losses arising from the guarantee arrangement, which amounted to over £55,000 during the first year of the experimental tariff. Personally, the directors would have preferred to continue the 4s. tariff a little longer, in order that it might have been fairly tested, but as the colonies were all suffering from severe commercial depression, and intimated that unless the tariff were increased they might have to cancel the guarantee at the end of the second year, the directors had no alternative but to acquiesce in their views. It was the first time in his (Sir John Pender's) recollection where a Government asked anyone to increase their charges. They had generally been asked by the commercial bodies to reduce rates. He might also say that when they fixed that rate at 4s., he advised them very strongly to make it 5s. instead of 4s.; he thought the reduction from 10s. to 5s. would be such a strong one that it would get more money out of the 5s. than the 4s., as it would be such a benefit to those who used the telegraph that there would have been as many messages as with the 4s. rate, and the colonies themselves were now practically carrying out his suggestion by asking for a 4s. 9d. rate. They (the directors) would have been better pleased to have tried it another year, but it was their wish to meet the colonies as far as possible, even in a financial matter. He was hopeful that the traffic would be as large at 4s. 9d. as it had been at 4s. If that was so, then the loss would be so insignificant as that he hoped in the future they would go on pleasantly and swimmingly. With regard to the expenditure, the working expenses had amounted to £79,621, against £71,476 for the corresponding period of 1891, showing an increase of £7,805. The usual interim dividend at the rate of 5 per cent. for the half-year had been distributed, and the substantial balance of £70,271 was carried forward. He thought they would agree with him that it was a very substantial position to put before them. In regard to the working of the system, a further length of 443 knots of the Rangoon-Penang cable was picked up, making, with the cable previously recovered, a total of 825 knots picked up out of 855 knots originally laid. The cable was mostly found to be in good condition, and had been valued at £42,324. £20,000 had been credited to the capital expenditure to replace the amount originally taken towards the cost of the cable, and the balance had been placed as shown in the printed accounts. He had often referred to the repairing of their cables, and he thought that a cable that had been down for some years, and could now be picked up and carried elsewhere, showed that they had a property which they could well deal with. Out of the picked up cable a triplicate line had been laid between Penang and Singapore, costing £4,974. Out of the picked up cable a triplicate line had been laid between Penang and Singapore, costing £25,974. The Foochow-Shanghai section had also been strengthened during the half-year by the partial renewal and alteration of the line at the mouth of the Yangtsze-Kiang river, where interruptions from ships' anchors were becoming frequent. The cost of this operation had been £5,307, and with the cost of the triplicate Penang-Singapore, it had been charged to the general reserve fund, which now stood at £426,642, after they had expended £1,162,694 out of revenue on cable, renewals, duplications, &c., since the formation of the company. This showed that, without increasing their capital, they had practically doubled the operating power of their system. They had really done more, because they had found out how to duplex their cables, which had given them an enormous cable power. The contract for laying a submarine cable between Acheen and the company's system at Sumatra on account of the Netherlands-Indian Government had been successfully carried out, and the line had been opened for traffic. The cost of the work had, of course, been defrayed by the government, and the line would, he hoped, eventually become a good feeder to the company's system. They had the satisfaction to announce that the competition with which the New Zealand cables were at one time threatened by the Government of that colony had been averted, and an arrangement had been come

to with the Government for reducing the charges over the New Zealand cables as follows:—For inter-colonial messages from 8s. 6d. to 2s. for ten words, and for international messages from 1s. to 3d. a word, the Government guaranteeing the company against three-fourths of the risk of any loss which might arise from the reduction, the company bearing one-fourth. The value of the traffic in question was £26,258, the company's risk being £4,386 if no increase of traffic resulted. With an increase of 50 per cent., however—which would not be an excessive estimate for such substantial reductions—the company's liability would be only £3,297. Their relations, therefore, with New Zealand were now thoroughly satisfactory, and he hoped that all the parties concerned would thus derive considerable benefit in the future. It had also been arranged for New Zealand to join in the Australian guarantee and receive the benefit of the cheap rates to Australia. The tariff between Europe and New Zealand would, therefore, be reduced from 10s. 2d. to 5s. 2d. per word for ordinary telegrams. The date for bringing the new tariffs into force had not yet been definitely settled, but it would probably be the 1st prox. For the last 20 years the company's relations with Queensland had not been satisfactory, and the Government of that colony had endeavoured in every possible way to oppose the company. The sum which Queensland would have to pay to reduce its tariff to the same rate as that which prevailed in the other colonies would be only £1,000 a year. The principal reason for the hostility of the Queensland Government towards the company was because the latter adopted another route instead of the Queensland system when telegraphic communication was first established with Australia 20 years ago. A short time since the merchants of London went in a deputation to the Queensland Minister of Telegraphs and urged upon him the desirability of his Government joining with the other colonies in the guarantee referred to. So far, nothing had resulted from the deputation. He could only say that they had done everything possible to conciliate Queensland and to endeavour to induce the Government of the colony to take a different view. It was recently pointed out by a member of the colonial Parliament that the inferior position which Queensland held in comparison with the other Australian colonies in this matter was prejudicial to her, and the Government were advised to put the colony on the same footing. The Prime Minister, however, replied that the Government would not join in any agreement that would give any assistance to monopoly. The Government had made an agreement with another company for a cable to New Caledonia, and the Prime Minister said he thought that they would be defeating their own object by assisting the Eastern Extension Company. He (the chairman) believed that they had agreed to pay £2,000 a year towards the New Caledonia cable—a project from which he could not see that any benefit would result to the colony. If, on the other hand, the Queensland Government gave up the policy which they were pursuing towards the company there was no doubt that they would very largely benefit the interests of the colony, and he had no doubt that the colonists would eventually insist upon this course being taken. In conclusion, the chairman said he doubted whether he had been able on any former occasion to put a more satisfactory account of the position of the company before them than he had done that day. He then moved: "That the report and accounts of the directors now submitted be received and adopted."

Mr. FRANCIS A. BEVAN seconded the motion, which was unanimously adopted.

A vote of thanks to the chairman and directors terminated the proceedings.

The Western and Brazilian Telegraph Company, Limited.

THE report of the directors for the half year ended June 30th, 1892, to be presented at the twenty-fourth ordinary general meeting of the company, on the 10th inst., reads as follows:—The total earnings amount to £84,021, 16s. 9d., as against £104,962 9s. 7d., a decrease of £20,940 12s. 10d. compared with the half year to June 30th, 1891. The working expenses amount to £39,140 16s. 8d., as against £38,638 10s. 0d., an increase of £502 6s. 8d. Including the amount brought forward from 1891 (£4,486 18s. 2d.), the balance to the credit of the revenue account is £49,367 18s. 3d., from which has to be deducted £12,489 10s. for debenture interest, and £6,610 10s. for the debenture redemption fund, leaving £30,267 18s. 3d., of which £14,000 has been placed to the reserve fund. This leaves £16,267 18s. 3d. The directors recommend the payment of a dividend of 3s. per share, free of income tax, on the ordinary shares for the half year, being at the rate of £2 per cent. per annum, carrying forward £1,662 5s. 3d. The shareholders will note that the falling off in the dividend is mainly attributable to the heavy loss on exchange which for the period of which the accounts treat averaged 11¼d. per milreis as against 18d. for the corresponding period of 1891. The duplication of the cables between Santos and Chuy has been successfully carried out by the Telegraph Construction and Maintenance Company, Limited, thus duplicating the system throughout between Pernambuco and the River Plate. The cables have also been duplexed between Pernambuco, Rio Janeiro, and Santos, and a contract has been entered into, and is now in course of completion, the materials being on the spot, for the extension of the duplex system to Monte Video. It will be seen from the above that the company will shortly have the duplicated line duplexed throughout the entire length of its main system, viz., from Pernambuco to the River Plate. The competitive cable projected between Senegal and Pernambuco, Brazil, has now been laid. Since the last meeting, the Pacific and European Telegraph Company, the object of which was then fully explained, has been formed, and the erection of the lines between Buenos Ayres and Valparaiso is being actively pushed forward and approaches completion.

Aluminium Company, Limited.

THE report of the directors for the 12 months ending June 30th, 1892, states that, though the trading account still shows a loss, the prospects of the company are more hopeful than they were, and the directors believe that the coming year will see their policy of perseverance justified. Heeley Mills are now closed. Although the profit and loss account at Oldbury shows an adverse balance, accounts were prepared and audited to December 31st, 1891, showing that the loss was all prior to that date. For the second half of the financial year the profit was about £2,600. Moreover, this profit was earned on a plant of only one-third of the capacity of that which the company now has at its disposal, and in face of large reductions in the actual selling price of sodium, which have been made, not by reason of competition, but to secure its employment in new chemical industries. Within the last few months Mr. Castner has invented a new electro-chemical process, directly connected with one of the largest chemical industries in England, which the directors believe will prove extremely valuable, and they have decided to put up plant, with a view to working the process commercially. They propose an issue of £12,000 "B" 10 per cent. debentures, to be secured as a first charge on the new process, and as a floating security on the undertaking of the company, subject to the first debentures. The debentures will be repayable within three years, so as not to become a permanent charge. The amount raised by these debentures will be sufficient for the requirements of the company, including the erection of plant for the new process.

International Electric Syndicate.—A notice in the *London Gazette* states "That a petition for the winding up of the above-named company by the High Court of Justice was, on October 25th, 1892, presented to the said court by George Herbert Hodgson, of Kirkfield, Baildon, Shipley, in the county of York, loom manufacturer, a shareholder of the said company, and that the said petition is directed to be heard before the court sitting at the Royal Courts of Justice, Strand, London, on Wednesday, November 9th, 1892, and any creditor or contributory of the company desirous to support or oppose the making of an Order on the said petition, may appear at the time of hearing by himself, or his counsel for that purpose; and a copy of the petition will be furnished to any creditor or contributory of the said company requiring the same by M. Webb and Sons, Barbican Chambers, Aldersgate, E.C., solicitors for the petitioner, on payment of the regulated charge for the same."

Electrical Assets Purchase Company.—The *London Gazette* announces that a general meeting of the members of the above-named company will be held on the 28th day of November, 1892, at two o'clock, at Wm. R. Taylor Carr's, the liquidator's, offices, Monument House, Monument Yard, E.C., in order that there may be laid before them an account showing the manner in which the winding up has been conducted, and the property of the company disposed of, and in order that the said company may hear any explanation that may be given by the liquidator; and also in order that an extraordinary resolution may be passed for determining the manner in which the books, accounts, and documents of the company, and of the liquidator, shall be disposed of.

Blackpool Electric Tramway Company.—The *London Gazette* announces "That the creditors of the above-named company are required, on or before the 30th day of November, 1892, to send in their names and addresses, and the particulars of their debts or claims, and the names and addresses of their solicitors (if any), to John Oddie, of Halifax, accountant, the liquidator of the said company, and, if so required, by notice in writing from the said liquidator, are, by their solicitors, to come in and prove their said debts or claims at such time and place as shall be specified in such notice, or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved."

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in, and to grant a quotation to: National Telephone Company, Limited—90,950 third preference shares, Nos. 1 to 90,950. (2) To allow the following securities to be quoted in the Official List:—National Telephone Company, Limited—Further issue of 6,378 ordinary shares, Nos. 447,435 to 453,812. Reuter's Telegram Company, Limited—Further issue of £1,000 shares.

Eastern Telegraph Company.—The Eastern Telegraph Company, Limited, announce that they are prepared to issue to the holders of their 5 per cent. debentures, redeemable at par in August, 1899, an equal nominal amount of their registered perpetual 4 per cent. mortgage debenture stock in exchange. Full particulars and the necessary forms can be had on application at the company's office.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 30th, 1892, amounted to £889; corresponding month, 1891, £802; increase £87; total receipts to date, 1892, £14,272; corresponding period, 1891, £12,973; increase £1,299.

The Cuba Submarine Telegraph Company, Limited. The estimated traffic receipts for the month of October amounted to £3,400, as against £3,366 in the corresponding month of last year.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of October, 1892, amounted to £2,307, against £2,436 in the corresponding period of last year.

The Eastern Telegraph Company, Limited. The traffic receipts for the month of October, 1892, amounted to £61,069, as against £60,874 in the corresponding period of last year.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 28th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, amounted to £3,099.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.	Closing Quotation October 27th.	Closing Quotation, November 3rd.	Business done during week ending November 3rd, 1892. Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100—103	100 —103	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	50½— 51½	50½— 51½	51½	50½
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	91 — 92	91 — 92	91⅞	90½
2,876,140*l*	Do. do. Deferred	Stock	11½— 12	11½— 11⅝	11 11/16	11 5/16
130,000	Brazilian Submarine Telegraph, Limited	10	11 — 11½	10⅝— 11½	11⅛	10 15/16
53,200*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3 — 3¼	3 — 3¼	3¼	3 1/16
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2 3/16
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2⅛— 3⅛	2⅛— 3⅛	...	...
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152 ...	10	10⅝— 11⅛	10⅛— 11	10 1/8	10⅜
$7,716,000	Commercial Cable, Capital Stock	$100	168 —173	168 —173	171	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	1/8— 3/8	1/8— 3/8	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos 1 to 20,000	5	5 — 5⅛	5⅛— 5⅜	5⅛	...
16,000	Cuba Telegraph, Limited	10	11½— 12½	11½— 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	17½— 18½	17½— 18½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼— 3⅜	3¼— 3⅜	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11½— 11⅝	11½— 11⅝	11⅝	11½
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	15 — 15¼	14⅞— 15⅛	15⅛	14 15/16
70,000	Do. 6 p. c. Preference	10	15½— 16	15½— 16	16	15 11/16
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	112 —115	109 —112 xd	111½	110
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅜— 15⅝	15⅛— 15⅜	15 5/16	15¼
70,600*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	103 —106	103 —106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	103 —106	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	109 —112	109 —112	111	...
122,400*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	103 —106	103 —106	105	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	103 —106	103 —106	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	103 —106	103 —106	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	4¼— 4⅜	4¼— 4⅜	4 1/16	4⅛
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/8— 3/8	1/8— 3/8	1/8	1/8
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1½— 2	1½— 1⅝	1⅝	1 3/16
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	¾— 1	¾— 1	1/8	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1 — 2	1½— 2½	2	...
180,227	Globe Telegraph and Trust, Limited	10	10½— 10⅝	10⅛— 10⅜	10 7/16	10 5/16
180,042	Do. do. 6 p. c. Preference	10	15¼— 15½	15⅛— 15⅜	15⅜	15 5/16
150,000	Great Northern Tel. Company of Copenhagen	10	18½— 19	18½— 19	19	...
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	5½— 6½	5½— 6½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½— 10½	9½— 10½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½— 22½	21½— 22½	22	...
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	43 — 45	43 — 45 xd	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½— 3½	2½— 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	3 7/16— 3 9/16	3 7/16— 3 9/16	...	...
10,000	Do. do. fully paid	5	5 5/16— 5 5/16	5 5/16— 5 5/16	5⅛	4⅞
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½— 7	6½— 7	...	...
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	104 —107	104 —107	...	...
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 5	4⅜— 4⅞	4⅞	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	14 — 14½	14 — 14½	14½	14
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½— 14	13½— 14	...	...
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	111 —113	111 —113	112½	...
48,000*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	1⅞— 2⅛	3½— 4	3 1/16	1 1/16
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	1/16— 1/16	1/16— 1/16	...	...
10,802	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅜— 8¼	8 — 8½	8 5/16	8⅛
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	7⅞— 8¼	8⅛	...
3,381	Submarine Cables Trust	Cert.	118 —122	117 —121	118	...
78,949	Swan United Electric Light, Limited ... ... (£3¼ only paid)	5	3½— 4	3½— 4	3⅜	3 1/16
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	44 — 46	45½	...
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	103 —106	103 —105	...	...
58,000	United River Plate Telephone, Limited	5	2¼— 2⅜	2¼— 2⅜	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 — 100	90 — 100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½— 7¼	6½— 7⅛	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	...	...
30,000	West Coast of America Telegraph, Limited	10	3 — 4	3 — 4	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	103 —107	103 —107	...	...
64,242	Western and Brazilian Telegraph, Limited	15	8½— 9	8½— 9	...	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	6 — 6⅜	6 3/16	...
33,129	Do. do. do. 5 p. c. Deferred	7½	2½— 3	2½— 2⅝	2½	...
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	105 —108	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph, Limited	10	1⅜— 1⅝	1⅜— 1⅝	1½	1 7/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10 — 10½	10 — 10½	10 7/16	10½
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	8½— 9½	8½— 9½	9	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	103 —106	103 —106	105½	105
$1,536,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	123 —128	120 —125 xd	123½	...
171,000*l*	Do. do. 6 p. c. Sterling Bonds	10J	100 —103	100 —103	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½— 6	5½— 6	5⅝	5½

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. BANK RATE OF DISCOUNT.—3 per cent. (October 20th, 1892).

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid 7½—7⅝.—Electric and General Investment, shares of £5 (£1 paid), 2⅜—3⅜.—Founders' shares, 200—225.—Elmore Foreign and Colonial Copper, Founders shares, 6⅜—7½.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20¼.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 2¼—3¼.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5—5⅛, 1st Preference Cumulative 6 per cent., £5 (fully paid), 5⅛—5⅜.—Liverpool Electric Supply Shares of £5 (fully paid), 5⅛—5⅜.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—10¼.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—10¼.—Do. Debentures, 102—103.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ⅛—¼.—£5 Preference (fully paid), 2¼—3.

THE FINANCIAL RESULTS OF THE FRANKFORT ELECTRICAL EXHIBITION.

THE preliminary estimates concerning the probable expenditure and receipts at various exhibitions generally differ considerably from the actual results eventually obtained. Sometimes the figures are on the right side, but more frequently deficits occur. The late Electrical Exhibition at Frankfort-on-the-Main forms no exception. A preliminary report as to the financial results was issued by the committee at the end of last December, and on Friday evening last a well attended meeting of the "Further Committee," under the presidency of Dr. Humser, was held in one of the halls in the Palmengarten in Frankfort, to receive the report drawn up by the Managing Committee regarding the financial results of the exhibition.

The report referred first to the causes which had brought about a greater expenditure and a less income than had been anticipated in the first and second estimates. The total amount disbursed was £66,304, of which £34,500 were upon the buildings and £31,804 on general working. As the expenses had been calculated to attain £56,475, the additional outlay came to £9,829, £3,714 of which devolved upon the buildings, and £6,115 on working expenses. After dealing with individual items, the report referred to the Lauffen line, and particularly in connection with the remarks made by Herr von Stephan on January 30th, 1891, on the occasion of the discussion in the Diet of that portion of the Budget concerning the Postal Administration. After speaking generally of the installation, its prospects and probable effect on the great and small industries of the country, Herr von Stephan remarked that he only wished to show that the money asked to be granted to assist in the carrying out of the project, although the amount was inconsiderable, would be utilised to the best advantage. Though these remarks were greeted with shouts of "Bravo!" and the financial support, after the warm words uttered by Herr Von Stephan, seemed sure, yet it was withheld; and the preliminary estimate by the Imperial postal authorities for the erection of the Lauffen-Frankfort line was also greatly exceeded. The first estimate by the Imperial Chief Postal Administration, for that part of the installation to be put up on the Imperial Telegraph district, amounted to £1,050; the second to £2,490; and the third to £2,956; whilst lastly, £3,621 had to be liquidated by Frankfort. The portion of the line in Würtemberg, estimated to cost £300, was only exceeded by about eight shillings. The amount to be paid towards the Lauffen line by the exhibition was £4,532, but from this had to be deducted £2,585 which had been contributed in various quarters; thus the exhibition actually only had to hand over the sum of £1,947.

It had not been anticipated that much expenditure would be incurred in connection with the Test Committee. It was, however, found that with the growth of the exhibition, and the work and apparatus of the committee, and therefore the expenses, so much increased, that a special account had to be established for it. As this state of affairs had not been foreseen, a number of gentlemen combined to meet the costs of the Test Committee, in so far as means were not at disposal to accomplish this object. Fortunately it had not been necessary to call upon these gentlemen for their guarantee. The total expenses of the Test Committee had been estimated at £1,400, to which the Society of German Engineers had contributed £100. This matter had not yet been settled, but it was not considered that the £1,400 would be exceeded.

Coming to deal with the receipts, the report stated that only in a few instances had the amounts of the estimates not been realised, whilst in various other cases much higher receipts were obtained than had been expected. The total income amounted to £71,194, thus having as against the outlay of £66,304 a balance of £4,890. The committee proposed, in accordance with an agreement with Herr von Miller, to hand over to him 15 per cent. (£734) of the balance, as compensation for his disbursements, and to devote half of the surplus of £4,156 towards repaying the subsidies, amounting in all to £2,702, granted by the Municipality, the Chamber of Commerce, the Metallgesellschaft, and Herr Mor. Oppenheimer, whilst the other half of the surplus would be utilised in helping to reimburse the exhibitors for £9,003, which they had paid for space and power. The repayment in the case of the subsidies amounted to about 77 per cent., and to exhibitors 23 per cent.

Herr Sonnemann briefly explained the reason for the difference between the preliminary surplus mentioned last December and that actually existing, various expenses having had to be met. With regard to the additional expenses for the Lauffen experiment, he remarked that it might have been possible to reduce the amount which the exhibition had to pay if the postal authorities had communicated at the proper time a correct estimate. They might then have been enabled, as a cessation or restriction of the experiment was out of the question, to secure other donations, and in this connection it might be mentioned that when the estimate had been reached no further contributions were received towards the experiment. The surplus had not permitted of all the obligations of the exhibition being fulfilled towards exhibitors, the town, the chamber of commerce, &c.

The "Further Committee" adopted the report, discharged the Managing Committee, and expressed its approval of the proposed method of dealing with the surplus.

Dr. Humser then thanked the Managing Committee and particularly Herr Sonnemann, for the energy displayed by him in the interests of the exhibition for nearly three years. This was warmly approved, and Herr Sonnemann in acknowledging the compliment, included the members of the various committees. At a supper subsequently given, a wish was expressed for the holding of a trade exhibition in Frankfort before the close of the century, and that the members of the Electrical Exhibition committees should participate in it.

SCIENCE AND ART AT SOUTH KENSINGTON.

OUR learned friends of the *Engineer*, with the Greek *noms de guerre*, are still unhappy about the future of the embryo engineer.

"It is high time that the shortcomings of the Science and Art Department were pointed out," says *Sigma Sigma*; and forthwith proceeds to demolish the system of engineering examinations in vogue at South Kensington. On the other hand, *Omicron Pie* takes up the gauge and expresses his willingness to break a lance on behalf of the engineering science classes.

There has been much cry and very little wool so far, and there seems to be no good in an extended correspondence on the subject. A proposal made by *Sigma Sigma* for the establishment of independent classes for students is, however, worthy of serious consideration by all large firms of engineers. Some years ago, when leading draughtsman, this gentleman, in conjunction with the chief, organised a series of classes open to any of the employés on payment of a small fee. These classes were held in the drawing office, which was lent by the firm for the purpose. The subjects dealt with in lectures and practice included the production and properties of raw materials; the elements of pure dynamics; dynamics applied to problems in machine designs; mensuration, &c., &c.; geometrical and mechanical drawing, and graphic calculation. They were all treated from a thoroughly practical standpoint, the first object being the training of apprentices to fit them for the drawing office staff. A competitive examination for admission to the drawing office was instituted at the same time.

This scheme is not a new one; but it is very rarely practised. Indeed it would appear that few firms take the question of apprenticeship in a serious light. If a pupil pays a premium he is supposed to *pass through* certain, or all, of the shops, and perhaps to spend a few months in the drawing office; but it is neither the special business nor the interest of any one to see that the lad makes the best of his time, and so the result depends greatly on the youth himself. If the apprentice be bound for a period of years without a premium, he stands a better chance, since he will, at all events, be compelled to work; but unfortunately he is likely to be kept to a few special classes of work—driving machine tools, perhaps—and therefore has no great chance of becoming a good all round man. The old system of seven years' apprenticeship, when shops were smaller and master and man more in touch with each other, had its undoubted advantages,

and most of the engineering giants of the first half of this century were produced under it. Technical education, competition, and even the general progress of machine production, have tended to make the old system almost impossible, and perhaps, as a whole undesirable; but there is a chance of a break down taking place during the transition to the new conditions necessitated by the present state of the engineering trades.

That technical education, rightly appreciated and properly applied, will ultimately turn out as good men as the old system did is our firm conviction, but some connecting link between theory and practice, such as that proposed by *Sigma Sigma*, seems to be necessary, if only as a stop-gap until something better is arranged. We should be glad to hear that many of the larger firms employed in the production of electrical machinery had taken this suggestion to heart, and that classes for the employés conducted by the staff, or with the assistance of outside aid, were in vogue.

IRISH'S THERMO-ELECTRIC ARC LAMP.

IN order that arc, incandescent, or alternating circuits with single, double, or magazine of carbons may be run singly or in series, and give a light varying from 500 to 3,000 candle-power according to the energy supplied, and also to burn from 8 up to 86 hours, or more for each trimming, the inventor of Irish's thermo-electric arc lamp has returned to first principles in the same way as he did in designing his thermo-electric telephone photo-electrograph, phonolytic

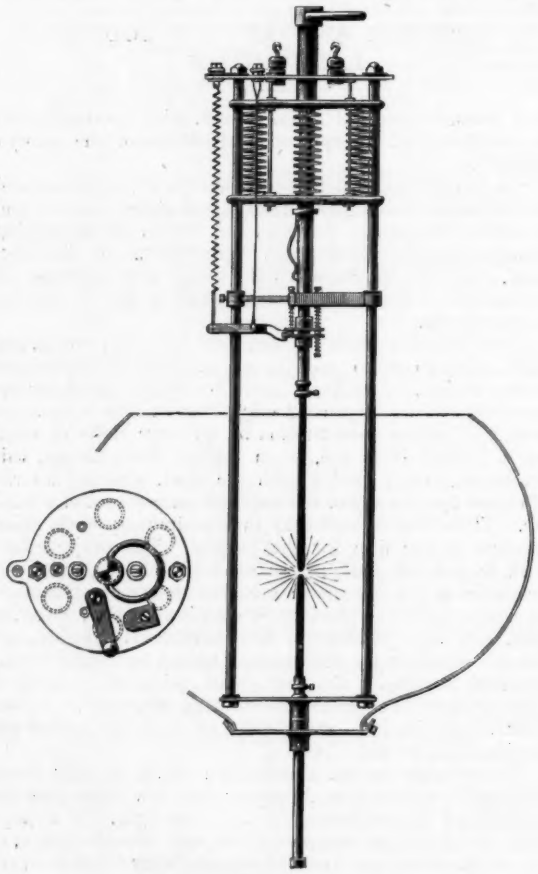


FIG. 1.

automatic cutouts, resistance regulators, and many other thermo-electric devices, several of which we have described.

In the present instance he simply substitutes for the electro-magnets usually employed to actuate arc lamps, a metallic strip affected to expansion by the thermal effects of the current passing through it to supply the lamps of which it forms a part. In combination with the thermal expanding strip he employs a bearer and counteracting spring. The thermal strip, bearer, spring and arc form a beautiful automatic balance, thus:

When the circuit is closed the thermo strip will expand by reason of the current, allowing the spring to recoil and raise one end of the bearer, which also lifts the upper carbon, thereby establishing the arc; then, as the arc varies in length, so in proportion will its resistance vary, and so will the length of the thermal strip correspondingly vary. This strip regulates the length of arc, and gradually and imperceptibly feeds the carbon so as to maintain a constant length of arc with an unvarying light.

Lamps may be removed from a circuit of low to a circuit of high tension, or to an alternating circuit, and *vice versâ*, and work perfectly. The lamps are easily and quickly adjusted while burning, and may readily be regulated to give a maximum length of arc by altering the length of the thermal strip by means of the nurled nut.

On high tension circuits the best regulation is when the hissing ceases, and on alternating circuits when the lamps burn without noise, or with very little noise. On very low

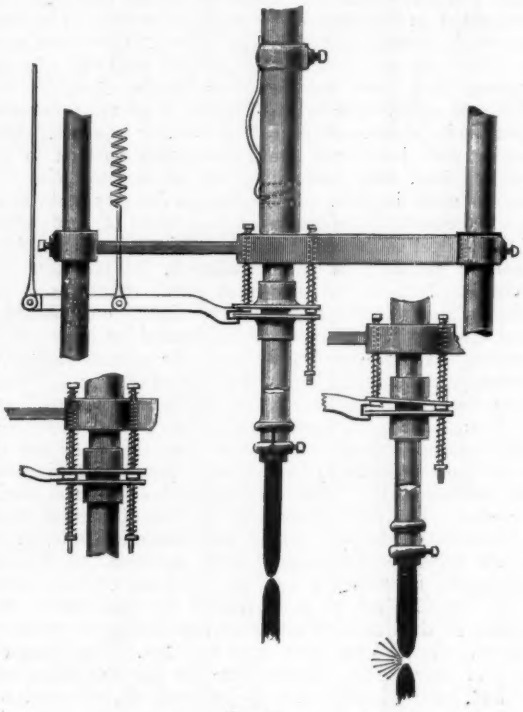


FIG. 2.

tension circuits the most satisfactory working limit of arc is reached just before the hissing appears.

Each lamp is provided with an automatic cut-out, as well as a hand switch, not shown in the figures.

The automatic cut-outs on a lamp running on an incandescent circuit will, as it operates and cuts out the lamp, introduce a resistance equal to that of the lamp when burning. It also makes the burning of each lamp of the series independent.

On an arc or alternating circuit the cut-out simply bridges the lamp terminals whenever the lamp circuit opens for any reason. The cut-out will only act when the lamp fails. This arrangement prevents lamps while burning from being affected by others that may become faulty on the same circuit, or have consumed their carbons, and it permits of lamps being trimmed while others on the same circuit are in use, should the hand switch be out of position. A shunt of high resistance is preferably employed with the arc lamp, but the simple automatic shunt without resistance gives excellent results.

Fig. 1 represents a simple form of single carbon lamp to burn from eight to seventeen hours on any circuit.

Fig. 2 is an enlarged view of the feed mechanism, showing the bearer, spring, and thermal strip actuating differential clutches, which feed the carbon pencil directly, without the aid of the usual rod. The chief advantage of this is that a carbon double the usual length may be used, and the resistance of the carbons remains a constant factor whatever their variation in length.

Fig 3 is from a photo of one of the first models of a

double carbon lamp. The upper carbons fall by gravity or their own weight. The lower carbon is raised by pressure of the mercury contained in the bulb. This lamp runs about seventeen hours without attention.

Fig. 4 illustrates a magazine lamp. The carbons in the upper magazine fall in succession, with their tapered ends entering a cavity in the top of the one preceding it. The drop of the successive carbons occurs when the lowermost one is about half consumed.

As the carbons burn away and become shorter, the point of junction becomes so heated as to temporarily soften the sealing compound contained in the cavity and cement

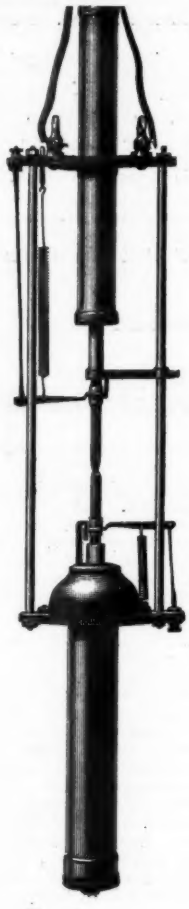


FIG. 4.

FIG. 3.

the two carbons together, so that they feed out as one continuous pencil. The carbons in the lower magazine also dovetail and cement together in succession as they feed up.

The lower magazine contains a quantity of mercury which is employed to force the burning carbons up when the current passes through the lower trip permits of it.

When the circuit is closed the upper carbon will be raised and the bottom carbon lowered. The upper one is raised twice the distance that the bottom one is lowered, thus maintaining the arc in a constant focal position.

REVIEW.

Electric Traction on Railways and Tramways. By ANTHONY RECKENZAUN, C.E. Published by Biggs & Co., Salisbury Court, Fleet Street, E.C., 1892.

Mr. Reckenzaun labours under two serious disadvantages in publishing his long promised work on traction at the present time. In the first place he has been anticipated by Messrs. Crosby and Bell, and secondly, so little traction work has been done on this side of the Atlantic that necessarily he has had to borrow extensively from American writers. However, he has made the best of his opportunities and his book is certainly interesting and instructive. As a whole it partakes of the character of a *rechauffé*, and is chiefly a collection of facts culled from the American and European technical press of the past few years. From this remark readers must not imagine that we depreciate its value, for so great a mass of data relating to one particular subject cannot fail to be useful to the specialist, and, moreover, the subject matter, though roughly arranged, is get-at-able by means of a convenient index. In the preface the author states that his aim has been to summarise as concisely as possible the present state of electric traction, and certainly he has succeeded.

The first chapter, after a terse historical introduction to the subject, deals with the magnetic field, and we are somewhat surprised to find the method introduced by Mr. Kapp some eight years' ago employed for the calculations. We thought the advantages of Dr. Hopkinson's method had been sufficiently recognised amongst both English and American engineers to make its adoption general. Mr. Kapp's plan consists in approximately pre-determining the characteristic curve; whereas, Dr. Hopkinson constructs an actual curve from experimental data and bases the design of the machine on the results thus obtained. We even thought that Mr. Kapp himself had been converted, but we suppose we are mistaken. The chapter concludes with Dr. Silvanus Thompson's time-honoured diagram for graphically finding the condition of maximum activity of a motor. And we are told *again* that this maximum occurs with an efficiency of 50 per cent.

Chapter II. is devoted mainly to the discussion of the power and current rate for a typical line with 12 cars, and it is shown that the consumption of fuel per car mile will be about 7·3 lbs of coal, and that this compares very favourably with that required for steam traction. The relation between the ampères and power for different grades is shown graphically in diagrams designed for series, shunt, and compound-wound motors, and the respective advantages and disadvantages of the three, when used with a rheostat, are shown. A diagram for a series motor with subdivided fields and no starting resistance is also given; and in the case in point the efficiency never falls below 60 per cent. Mr. Reckenzaun has paid special attention to load diagrams and he shows the important lessons that may be learned from their careful study. The very "character" of the driver, he says, may sometimes be determined if only one car be running, and so the importance of skilful driving is made apparent.

Figs. 20 to 22 are the load diagrams obtained from three different systems of electric cars on the overhead trolley line at Des Moines, U.S.A. The tests were made under similar conditions and the cars operated by the same driver. The first car was fitted with two 15 H.P. Thomson-Houston motors; the second with two 15 H.P. Sprague motors; and the third with a pair of 15 H.P. Westinghouse motors. The tests show that at starting from 20 to 50 E.H.P. are required. The average speeds of the three cars varied from 20 to 24·49 miles per hour, and the corresponding average electrical horse-powers absorbed varied from 13·6 to 15·49. The speeds in the three cases being so different it is not possible to say that any one of these motors is superior to the other two. Yet the diagrams are full of interest to the specialist. The author states that the mean tractive force on general tram roads varies between 30 lbs. and 50 lbs. per ton, although, under specially favourable conditions, it may be as low as 20 lbs.

Referring to the method of supporting part of the motor on the rolling axle, Mr. Reckenzaun claims for it the advantage that it assists the starting of the car. He says, on page 110, "as the car starts there is an initial torque upon the armature which, before the car wheels begin to rotate, tends to compress the spring, which in resuming its former shape helps to start the car." We do not see the force of this. A spring in the drag-bars of a tramcar does not lessen the pull required to overcome the inertia of the car at starting, it only tends to lessen the shock on the horses. And likewise the spring which carries part of the weight of the tramcar motor only tends to lessen the initial shock to the armature.

Speed regulation devices, brush and switch details, car wirings and motor gearings, are discussed at some length. We find the author still strongly advocating a worm and worm wheel for tram-car work. Experience has always been opposed to the use of high speed worms, and

it is certainly remarkable that the extended practice in America points most strongly to the use of spur gearing in spite of the compactness and simplicity of worm gearing. The gearless motor is not referred to at length, for the author recognises the difficulties in the way of slow speed motors for tram-car service.

In Chapter V. the construction of overhead and underground lines is treated in a thorough manner, and illustrated by reference to prominent installations. A tribute is also paid to the versatility of Professors Ayrton and Perry, who, to quote the author, "were far too early with their exceedingly clever devices." It is undoubtedly a fact that the principles and many of the details of electric traction plants were fully described by these engineers quite ten years ago.

Mr. Reckenzaun has discussed very fairly the position of accumulator traction, and does not hold out any visionary hopes of a cheap and efficient battery from developments of the types now most in vogue.

The sixth and seventh chapters are mainly a description of various well known traction plants and a "*résumé* of the writings and expressions of several prominent electrical engineers;" the contents are more or less familiar to the readers of the technical journals, and so are chiefly of value to the student for reference. A large number of tests—some old and some not to our knowledge previously published—taken on different lines are decidedly interesting: those referring to the City and South London Electric Railway especially so.

Mr. Reckenzaun has also collected the figures of the working expenses for a number of lines in Great Britain, Europe, and America, and these give a ready means of estimating the probable working costs of any scheme which may be proposed. Summarising the results, he shows that in only one case (Frederal Street and Pleasant Valley Railway Company, Pittsburg, Pa., where the conditions are exceptionally severe) does the ratio of operating expenses rise above 60 per cent. of the gross receipts; and that in most it averages from 48·6 to 57·8 per cent. For horse traction the average ratio of expenses is 80 per cent. of the receipts. This clearly demonstrates why electric traction meets with so much approval wherever it has been tried.

"Electric Traction" is much better edited than the last work published by Messrs. Biggs & Co., although it shows signs of careless *reading* in places. The paper, printing and illustrations are good, and the volume is of handy size for reference. On the whole we congratulate Mr. Reckenzaun, and sympathise with him for having been to some extent forestalled by Messrs. Crosby and Bell.

NEW PATENTS—1892.

18,538. "A new construction of underground conduit for electric conductors." T. WALLACE. Dated October 17th. (*Complete.*)

18,542. "Improvements in certain brackets or supports for electric arc lamps, applicable also for supporting lamps of other kinds." J. K. GRINDROD. Dated October 17th.

18,602. "Improvements in electrical appliances for canes and analogous articles." S. D. SMITH and O. J. WELLS. Dated October 18th.

18,655. "Improved buildings with means of access thereto to supply them with water, gas, also electric light, with electric and steam power, and means to abate smoke." H. SHAW. Dated October 18th.

18,661. "Improvements in electrical communication between lightships and other vessels, and for other purposes." J. H. BARRY. Dated October 18th.

18,681. "Improvements in underground conductors for the distribution of electricity." S. W. BAYNES. Dated October 19th.

18,695. "Bannister's new and improved electric railway signal and point working system." C. A. BANNISTER. Dated October 19th.

18,700. "Improvements in electrical ceiling roses." T. G. POOLE and WOODHOUSE & RAWSON UNITED, LIMITED. Dated October 19th.

18,716. "Improvements in electric wire or cable conductors or conduits." A. K. FOOTE and H. R. POTTER. Dated October 19th.

18,732. "Improvements in the regulating devices of alternate current arc lamps." J. S. FAIRFAX. (Communicated by Messrs. Schuckert & Co., Germany.) Dated October 19th. (*Complete.*)

18,763. "Improvements in and relating to electric apparatus for playing mechanical pianos, organs, and other keyed musical instruments." A. A. MUGNIER. Dated October 19th.

18,789. "An improved method of registering the value of an electrical current on one meter where the price per unit varies for different services." G. H. DRIVER. Dated October 20th.

18,807. "Electrodes for secondary batteries." E. ANDREOLI. Dated October 20th.

18,817. "Improvements relating to galvanic batteries." J. A. MCMULLEN. Dated October 20th.

18,844. "Improvements in dry cells or galvanic batteries." H. KOLLER. Dated October 20th.

18,847. "Improvements in alternating current motors." H. F. JOEL. Dated October 21st.

18,866. "Improvements in and connected with the protection of electrical conductors and fittings." A. JAMIESON and C. R. G. SMYTHE. Dated October 21st.

18,868. "Improvements in unions for electric chandeliers." E. BALLET. Dated October 21st.

18,878. "Improvements in the connections of the parts of earthenware articles employed in connection with electrical switches, cut-outs, ceiling roses, and the like." T. TAYLOR and W. TUNNICLIFF. Dated October 21st.

18,926. "Improvements in switch lamp holders for electric lighting purposes." F. G. HOWARD. Dated October 22nd.

18,966. "Process for the electrolytic decomposition of compounds of metals and sulphur." SIEMENS BROS. & CO., LIMITED. (Communicated by Messrs. Siemens & Halske, Germany.) Dated October 22nd.

18,982. "Improvements in telephonic apparatus." E. P. DAVIS. Dated October 22nd.

18,994. "Improvements in electro-magnets." I. A. TIMMIS. Dated October 22nd.

19,019. "Improvements in arc lamps." F. JUKES and J. CHARLES. Dated October 22nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

4,479. "Improved means for insulating underground electrical conductors." L. F. H. C. MORGAN-GRENVILLE. Dated March 12th. The inventor threads upon the conductor, either before or after introduction to the pipe, a series of hollow cylinders, perforated spheroids, or other conveniently-shaped bodies resembling "vertebræ," and made of earthenware, glass, or other suitable non-conducting material. The pipe is then filled with oil. 2 claims.

4,881. "Improvements in electric tramways or railways." A. M. CLARK. (A communication from abroad by S. Schuckert & Co., of Nuremberg.) Dated March 18th. A continuous conductor is laid on the floor of a sealed tube, preferably of non-magnetic material, and is in the form of a flat strip. Along the upper side of, and within, the tube is fixed an intermediate sectional conductor whose lengths correspond to, and are respectively connected by wires with, the sectional conductor with which the brushes on the car make contact. The sections of the intermediate conductor are insulated from each other, and from the main conductor, but are capable of being put in electrical connection therewith, by a mass of iron filings, or other divided form of that metal, which is caused, under the influence of magnetic induction exerted by electro-magnets mounted beneath the car, to bridge over the space between the continuous and the intermediate sectional conductor as the car travels along, thus putting the former continuously into electrical connection with the sections of the sectional conductor with which the brushes on the car for the time being make rubbing contact in the usual manner. 3 claims.

5,461. "Improvements in masts and trolleys for the overhead system of electric traction." A. DICKINSON. Dated March 28th. A mast, formed of metal or other approved material, is attached, near the heel, to a car, dummy or motor, by means of a ball and socket joint so as to allow the mast to radiate in any direction, the radiation being controlled and adjusted by means of springs attached near to the heel of the mast, the springs being secured to a loose collar working on the pedestal of the ball and socket, or in other suitable manner. The radiation of the mast is further controlled by means of adjustable buffer springs which are secured, in any desired position, to a frame attached to the before-mentioned pedestal of the ball and socket, or other suitable means. To the point or head of the mast is fitted a trolley, or collector, hinged so as to give it lateral play in any direction, the wheels of the trolley or collector, which are intended to work under the wire conveying the electricity, are protected and kept in position by means of guides which extend above the said wire conveying the electricity, the guides work upon a pivot or hinge, and are kept in position by means of a spring or springs which permit of the guides opening to pass any obstructions. 1 claim.

5,713. "Improvements in insulating electrical conductors." SYDNEY PITT. (Communicated from abroad by E. C. Davidson, of New York.) Dated April 2nd. The inventor takes a twisted ribbon of paper or a paper cord, and having dampened it by steaming or otherwise, passes it through rolls by which it is pressed into the form of a flat ribbon or tape. This tape has great tensile strength, and may be wound upon small or large conductors in any manner desired. One or more such windings may be applied around the wire, and over such winding may be wound a smooth flat ribbon as a kind of envelope. 2 claims.

5,714. "Improvements in insulating electrical conductors." S. PITT. (Communicated from abroad by E. C. Davidson, of New York.) Dated April 2nd. The object of the invention is to provide

an insulation with air spaces next the wire, which serve to reduce the static capacity of the insulated conductor, and also to increase the tensile strength of the paper ribbons wound around the conductor whereby liability of breakage and the consequent stoppage of machinery are reduced. To this end the inventor winds spirally around the conductor twisted paper. The paper may be loosely twisted into a somewhat rove like form, and if applied damp, will, when dry, contract and more firmly grasp the conductor. 6 claims.

5,715. "Improvements in insulating electrical conductors." S. PITT. (A communication from abroad by E. C. Davidson, of New York.) Dated April 2nd. The purpose of this invention is to decrease the static capacity of insulated electrical conductors. To this end air spaces next the conductor are provided by laying cords against and parallel with the conductor, and enclosing the whole in a lead sheath. 1 claim.

5,802. "Improvements in holders for incandescent electric lamps." W. MCGEOCH, jun., and A. J. MCGEOCH. Dated April 4th. The inventors employ a metal shell or casing, which may be like any suitable known kind, comprising two parts connected together by an external screw coupling ring or otherwise. In one part of the casing there is fixed a small block of vulcanised fibre, or porcelain, or other suitable non-conducting material, fitted with spring contact pins. In the other part of the casing there is fitted a smaller non-conducting block or disc, made with two perforations through it for the ends of the conducting wires. The conducting wires are threaded through the perforations, and have their ends fixed upon the inner side of the non-conducting disc by screws, with or without small plates or washers. The heads of the screws make contact with the spring pins hereinbefore referred to when the two parts of the casing are screwed together. The non-conducting disc and the non-conducting block are made, one with a diametrical rib, and the other with a counterpart groove, which engage with each other when the parts are put together, and prevent short-circuiting by a wire end accidentally getting across from one fixing screw to the other. 1 claim.

5,835. "Improvements in or relating to electrical measuring or indicating instruments." A. D. JONES. Dated April 4th. The inventor uses a volute or coiled spring, preferably of few turns. This he attaches at the inner end to an axle or arbor, to which (or to the end of the spring) is secured the index finger. The other, or outward end of the spring is connected by suitable means to the moving part under the influence of the current, so that any motion applied to the outward end of the spring tends to turn the index finger to a corresponding extent. 3 claims.

5,918. "Improvements in electric batteries." H. I. HARRIS and W. H. POWER. Dated April 6th. The exciting agent is a column of liquid, *e.g.*, water, which is admitted into the cavity of the case or outer jar of the battery to there press upon the outer surface of the inner cell. The outer jar is, or may be, of iron, and the inner cell of sulphur. As the generation of current proceeds, a percolation of liquid through the side of the cell or through the diaphragm takes place. Any suitable device of the syphon, or other type, is provided to carry off the liquid which has so percolated. 3 claims.

6,029. "Improvements in electro-depositing copper, brass and bronze, parts of which improvements are also applicable to other electrolytic purposes." W. H. WALENN and I. A. TIMMIS. Dated April 8th. The solution which is preferred for electro-depositing copper is worked at a temperature of 130° Fahr. or thereabouts, and is charged with copper partly by electrolysis and partly by the subsequent addition of ammonia-cupric oxide. The ingredients used to make the solution are of special character, and are made in a manner peculiarly suitable to their thoroughly efficient use in this invention: they are:—Cyanide of potassium, containing 40 per cent. of real cyanide—KCN. Neutral tartrate of ammonium, made by the addition of ammonia water (specific gravity ·880) to an aqueous solution of tartaric acid of a certain strength. Ammonia-cupric oxide made from freshly precipitated hydrated oxide of copper, dissolved in ammonia water of specific gravity ·880, in a closed vessel, until no more hydrated oxide is taken up. Water.—Distilled water is preferred, but pipe water as used for the supply of towns may be used. 9 claims.

6,030. "Improvements in electro-depositing copper, brass, and bronze." W. H. WALENN and I. A. TIMMIS. Dated April 8th. Consists in the use of free ammonia in alkaline solutions for depositing copper, brass and bronze, by means of electricity, in conjunction with means for preventing the escape of the ammoniacal gas during electro-deposition, and, if desired, for using the solution under pressure. 4 claims.

6,318. "An improvement relating to medico-electric batteries." N. MITCHELL. Dated April 13th. The inventor makes short tubes of gutta-percha, India-rubber, or other equivalent insulating material, and inserts them at the upper and lower parts of the element between the metal thereof as distancing pieces, as insulators, and to serve in conjunction with the open work of the outer metal as a retainer of the exciting liquid for a longer period than that possible by the threads now employed. 1 claim.

6,492. "An improved holder and shade for electric glow lamps." C. BARTER. Dated April 15th. The holder comprises a cylindrical piece of metal, wood, vulcanite, porcelain or other suitable material, provided at the bottom with a spring or springs, so arranged that when inserted in a candlestick (for example) the spring or springs serve to keep the holder firmly therein, in a vertical position. The upper part of the holder is tubular for a short distance down—at least—with two communicating holes—one on each side, preferably formed in a downward direction. These are intended for the two conductors for the lamp, which, entering one on each side from below, pass into the central hole to the top, and connect in any convenient manner with the terminals of the lamp. 1 claim.

18,093. "A new or improved automatic circuit-closing device for electric fire alarms." E. J. ELKINGTON. (A communication from abroad by the Compania Electricista contra Incendios, of Madrid.) Dated October 21st. Relates to a device which shall automatically complete the electric circuit when the temperature suddenly rises to the point at which the instrument is set to act, but which shall not so complete the circuit should the temperature rise gradually, as it may do under normal conditions, to the said point. 2 claims.

CORRESPONDENCE.

Water Wheels.

I have to thank Mr. E. Tremlett Carter for his reply to mine on this subject, but unless he can say that with the brake on the shaft of the turbine and the water measured in a cistern, he has got the 70 or 75 per cent. he mentions, he must kindly excuse me, if I persist in saying that I believe "their useful effect is vastly overrated;" and as electricians are now constantly called upon to put small electric lighting plants in country houses where water-power is to be used, I think we had better try to find what real grounds exist for the general faith there is in them.

On two occasions I have put turbines, by different makers, to this test, and failed to get anything like the figures mentioned.

Then I went to my books and tried to find the authority for getting 75 or even 70 per cent., but failed.

I found two volumes, about as much as I could carry, about the tests by flumes at Holyoke, but on looking through them I returned them to the library, convinced that the figures were not worth the paper they are written on.

Mr. Carter refers me to the fact, "that the experienced engineers engaged in developing the power of Niagara are working on the lines of a design which is based on a high efficiency in water motors."

But why should I sit at the feet of the engineers of Niagara to learn wisdom?

On May 13th, 1852, I signed articles of apprenticeship, and for more than 40 years I have sunk shafts and made tunnels in every sort of material, from blue basalt to quicksand, and have made tests of every kind of machine and apparatus likely to afford data useful in my professional work—how are they more experienced engineers than myself?

The Niagara scheme I have watched from its infancy. There never was the slightest difficulty about it; if the turbines don't realise all the work they anticipate, there is an abundance of water to fall back upon, to get all, and far more, than they will ever want. I have filed every scrap of information that I have met with, both in the technical journals and the daily press, on the subject, and I see one of my last notes is from the *Leeds Mercury*, June 21st, 1892:—Edison had been called in "to examine the ground, study conditions and plans, and give an opinion as to the practicability of the work." He was probably consulted on the electrical features; and it is also stated, "a little cheque for £8,000 was slipped into his hand." He would, no doubt, say, "Bless you, my children; proceed forward." I should expect that he was quite warranted in doing so.

The "Niagara," like the "City and South London Railway," and the "Manchester Canal" schemes, will be very fine engineering feats, but I don't think one of them will ever pay.

However, those are commercial questions in which I have no interest; the money is much better spent that way amongst engineers, contractors, and workmen, than in, say, horse-racing or fox-hunting, to which a large portion of our rural population devote their wealth, having no other visible means of occupation.

A. L. Steavenson.

October 29th, 1892.

The Problems of Commercial Electrolysis.

Being greatly interested by the many new and strange things found in Mr. Swinburne's paper, "The Problems of Commercial Electrolysis," I committed them to memory, and have been anxiously waiting, week by week, for the publication of some other body's opinion, or "The Discussion."

It is with great pleasure that I see you have taken up the matter. In view of this and the probable early discussion, I

have been looking up authorities, &c., and verifying my notes.

Sometime ago, while comparing your account of the Siemens & Halske process (ELECTRICAL REVIEW, September 2nd) with that in the *Engineering and Mining Journal*, I came across (in the same volume) an account of the Hoepfner process, which contains statements at variance with those of Mr. Swinburne.

This morning, while again looking over this volume (for M. Thofehrn's process, p. 669), I came across a very good account of the chlorate of potash plant at present at work in Switzerland, including the "fixings" for the anode.

My object in writing was to call your attention to this description, *Engineering and Mining Journal*, June 11th, 1892, p. 615, as a reference to it, or an abstract of it, might be of service to your readers.

I believe the figure $37,300 (in M. Thofehrn's process) to be wrong for first cost, but have not been able to verify this yet.

Charles Powell.

November 2nd, 1892.

Study of the Influence Machine.

I am much obliged to Mr. Gray for pointing out that the immersion of an influence machine in oil has been previously tried by Hempel, of which I was not aware. The failure may have been due to a variety of causes, but not being acquainted with the details of the experiment, I do not propose to enter into them at length.

I can hardly agree with Mr. Gray, however, as to the dissipation of the charge by convection.

No liquid insulator can compare with air for specific resistance, and an oil which would appear a fairly good insulator, with a reflecting galvanometer, might quickly dispose of the minute charge contained on a metal disc by leakage alone. I have endeavoured to show that what is known as a convective discharge is due to a severing of the lines of strain in the dense fields immediately around the discharging points; and, this being so, oil will, on account of its dielectric strength, allow of discharge by convection much less readily than will air.

J. E. Taylor.

October 31st, 1892.

Underground Mains.

A good deal has recently been written on the heavy leakages and other troubles due to electrolysis which have taken place in the underground mains system employed by several of the Paris companies. This has been attributed to the extensive use of bare copper conductors supported on insulators. We take this opportunity of pointing out that such troubles have not occurred in England, although the use of bare copper conductors has been very extensively adopted in London and in other towns. As we were the pioneers in the matter, we wish to explain the points wherein our successful English practice differs so very completely from the unsatisfactory practice that has been adopted in Paris.

Seven years ago, when we were responsible for the design, as well as for the contract, for the works of the Kensington and Knightsbridge Company, we proposed to the directors the use of bare copper conductors, and accepted all the heavy risk and money responsibilities which such a novel system of underground conductors would have entailed if it had turned out to be a failure. Now that its success has been proved, we consider we are entitled to whatever credit and saving has attended the system.

In working out our system of bare copper underground mains we, at an early date, saw the absolute necessity of so arranging the insulating supports that everyone of them could be instantly accessible for the purpose of being cleaned or replaced. We therefore devised means of putting our conductors under considerable strain, so that the number of insulating supports could be reduced to about 120 per mile, that is about 14 yards apart, instead of being spaced about 2 yards apart, as is necessary if the bare conductors are supported on mere notches in earthenware or other insulating bridges. Those who have examined our system in the West End of London and elsewhere will have noticed at intervals of about 14 yards the covers of the openings at which access can be given to every insulator. We use separate cylindrical insulators of the lipped or telegraph form, one for each conductor, which gives great insulating surface and prevents the accumulation of moisture, and, as a result, we can guarantee a degree of insulation that is quite impossible when a large number of mere notched insulators are used, even when the latter are quite new. Our system, commenced seven years ago, has yielded unexpectedly satisfactory results. The means that we have adopted to prevent the access of water and gas has been perfectly successful, the insulation resistance of the whole system has been far higher than has ever been the case where continuously insulated cables were used, for reasons which will be readily understood by those practically acquainted with the maintenance of an underground network connected direct to the houses. All practical engineers in charge of such systems know that 90 per cent. of such leakage as exists on a supply company's system occurs either at the junction of the house service lines to the company's mains, or to the service lines themselves just within the consumer's premises. As in our bare copper system these junctions are made in the street boxes and can be instantly examined or detached for testing purposes, it is found in practice that the localisation of leakages is greatly simplified, and hence the leakage itself greatly reduced.

If we are right in insisting that the culverts should be made impermeable to water and gas, and that the insulators should be so arranged as to give great insulating surface and be completely accessible for cleansing and repairing purposes, it will be seen that the troubles in Paris can be readily accounted for. The Paris engineers came over to see our system during its earlier stages and copied it in some respects, but, in others, fell into the very errors that we had already avoided. They still continue to use a great number of insulators placed close together, these insulators being of a poor insulating quality, and the great majority of them being completely inaccessible. They take no pains to make their culverts impermeable to water and gas, and no arrangements have been made to enable them to inspect or clean their system. We think that the unsatisfactory results in Paris should be a warning to some English engineers who appear to think that the good results we have obtained can be equally well obtained by the use of mere notched insulators placed close together, but we very much fear that the great reduction of surface, and difficulty in keeping these surfaces clean, will cause a repetition of the Paris troubles. The fact, however, has now been proved beyond doubt that a well designed bare copper underground system is superior to any existing system yet tried for a low pressure distribution network.

Such a system costs less for maintenance, testing, cleaning, and coupling up to, than any other system with which we are acquainted.

Crompton & Co., Limited.
R. E. CROMPTON, *Managing Director.*

November 1st, 1892.

The Rising Generation.

Not a very promising outlook for students of electrical engineering presented itself to me during last week, while passing through the West End, my attention being drawn to two men who were evidently engaged in overhauling the lamp fittings of an important public establishment. It is an acknowledged fact that we must not always judge by appearances, but to see men who bore every outward sign of being excavators or navvies, of the most inferior type, removing incandescent lamps and examining the holders (possibly for a short circuit or bad contact), their clumsiness suggesting at the same time that they would proceed to rectify same (if found) with the assistance of a cold chisel or road pick, it made one feel sympathetically for the rising generation of assistants, who, in many cases, have paid high premiums, and possess that amount of technical knowledge which would qualify them to make such examinations, which, although simple, necessitates a certain amount of delicacy and care, and also an operation that should be on the rôle of their progressive duties.

Am sure the profession generally will agree with me that it is nothing short of a disgrace for any firm or company to employ such class of labour on such work.

S. B. McClellan.